

**Report**

**Aug. 11, 1997 – Aug. 31, 1999**

**To**

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**Fleet Trials for Fuel Grade Methanol**

**Under**

**USDOE Cooperative Agreement No. DE-FC22-92PC90543**

**Performance Period 8/11/97 – 8/1/99**

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## **Listing of Project Personnel**

1. Dr. John Thomas, Principal Investigator
2. Richard MacKenzie, Director, Florida Tech Vehicle Maintenance
3. Alternative Automotive
4. Mr. Greg Leonard, Consultant
5. Mr. Greg Palubin, Research Assistant
6. Ms. Leigh Eward, Research Assistant
7. Mr. Michael Meneses, Research Assistant
8. Mr. Frank Aransky, Research Assistant
9. Mr. Steve Roth, Research Assistant
10. Mr. Jeff Reilly, Mechanic
11. Mr. David Cash, Mechanic
12. Mr. Carlos Terreaux, Research Assistant

## **1. General Introduction**

The objective of this project was to place two methanol cars and a methanol bus into routine operation and determine what performance/emission problems were caused by running internal combustion engines on methanol. As the work is event driven over two years, this final report will consist of a general introduction, edited versions of the quarterly reports, a general conclusion, and an appendix.

## **FIRST QUARTER**

### **1. Introduction**

The first priority in the first quarter of this project was to return the methanol-powered car and the Blitz bus to normal operational status. Both vehicles were at one time operating normally but had not been driven in at least five years. The greatest need was to acquire Avocet, an ignition enhancer for methanol, for the diesel bus. The only time the bus performed acceptably in service in Jacksonville, was when Avocet had been added to the methanol fuel. Avocet also contains a lubricating additive, necessary for dependable performance.

Cleaning the vehicles was second priority. The methanol car (a 1988 Chevrolet Corsica) had several old decals adhered to its exterior that needed to be removed. After removal of all decals from the car, it became obvious that repainting was still necessary. The bus, virtually covered in black algae on the outside and covered with graffiti on the inside, required intensive cleaning.

The third priority was to do all necessary mechanical work to make both vehicles operational. This required new injectors for both the car and the bus, a starting system for the car (for cold weather), new fuel line fittings for the bus, and a new exhaust system for the car.

## **2. Activities (as recorded by the staff)**

Activities performed in the first quarter of the contract period are reported below in chronological order:

1. Many potential sources of Avocet were contacted, including John Sheehan, ICI America; Anthony Stiff, ICI South Africa; Glyn Short, Consultant; Don Dudzinsky, SCAQMD; Dr. Carroll Goering, University of Illinois; Charles DiCiuccio, DDC (Detroit Diesel Corporation); and Larry Roemer, DDC.
2. Removal of old emblems from the Corsica was begun, using a heat gun.
3. The bus was washed and crayon marker graffiti was removed from the seats.
4. Erik Gordon briefed fleet trial participants about the bus: fuel lines, fuel pumps, fuel tanks, fuel line fittings, injectors, methanol conversion manual; and the Corsica: computer programmer, fuel pump.
5. The Corsica was towed to the FIT campus for repairs.
6. The bus' fuel line and stainless steel fuel line fittings, and the Corsica's injectors were inspected by Aeroflex Company Representatives. A sample of the Corsica's injectors was taken to determine availability. A price list for possible needed items would be forwarded to the trial participants.
7. More emblems were scraped off of the Corsica.
8. The Corsica's engine plemun was removed by a campus mechanic. The fuel injectors were also removed and checked for clogging. The car was given an oil change.
9. Emblem removal continued for the Corsica.
10. Cleaning of the injectors with carburetor cleaner was begun. Two injectors appeared okay.
11. New fuel injectors for the Corsica were obtained from GM.
12. Leftover emblem glue was removed from the Corsica with woodgrain remover purchased at Thompson PBE.
13. A new conventional fuel pump was installed in the fuel tank by campus mechanics. It was tested for proper pressure and found to be within acceptable tolerances. An attempt was made to start the car but only one injector was working, and it did not start. Hoses coming out of the fuel tank were replaced.

14. The fuel injectors were found to be too short in length; hence, they could not be used.
15. The interior of the Corsica was cleaned. Diagrams of the old injectors were faxed back to GM (Frank Ament) to show the actual size we need, and having the same flow rate as the originals.
16. The bus was towed over to the FIT campus.
17. The interior of the bus was cleaned. The Corsica was taken to the muffler shop. There is a constant drain on the bus battery that has not been found.
18. Twenty-five gallons of Avocet were received from the University of Illinois.
19. Twenty-five gallons of Avocet were received from SCAQMD Diamond Bar in California.
20. The injectors were removed from the bus and cleaned. One out of the six injectors was deemed unusable, as the tip was in poor condition. The Corsica was returned from the shop and driven to Bio-West for a fill-up (~5 gal.). There was a noticeable delay when starting from a full stop.
21. An analyzer was employed to determine why the Corsica was not performing well. It checked out satisfactorily. A bad connection on one sensor (MAF) was repaired and the car was operated for 30-40 minutes. Hesitation was intermittent, though not constant, and otherwise, the car ran well.
22. The Corsica was painted and fitted with a new hood. New custom made injectors for the bus were obtained. The staff familiarized themselves with the bus engine and its manual.
23. The Corsica was driven from the paint shop to Bio-West and two gallons of methanol were added.
24. The tires on the Corsica were replaced.
25. The staff continued to learn about the bus engine components, including fuel lines. Loose air lines for the air brakes compressor were tightened. The location of the computer (ECM) was checked. Both halon fire extinguishers on the engine compartment were checked and found to be in working order. Air pressure was introduced into the system to test the front door; and the door was found to be operating acceptably (the rear door was not connected to the system). The air conditioner compressor and lines were inspected. Oil in the crankcase appeared clear but the oil filter tube was corroded internally. Transmission fluid was checked, and did not require changing at this time. No leaks were found in other air lines. The batteries were disconnected and the throttle plate actuators (vacuum) were inspected.
26. New injectors with a  $180 \text{ cm}^3/\text{cycle}$  flow rate were ordered for the bus from Roy's Diesel Injection, 4020 Lenox Av. Jacksonville, FL. A starting system to correct the cold starting characteristics of the engine is needed for the Corsica. Ether was used to get it running for a short time. Need for an ether injection system is indicated.

27. A cold weather ether quick start system (NAPA 605-3270 kit and 605-3252 cylinder) was installed. Injectors with a  $195\text{-cm}^3/\text{cycle}$  flow rate were received from Roy's Diesel injection.
28. The installed cold start system worked well in the Corsica.

### **3. Results and Discussion**

The custom-fabricated fuel injectors, used by GM in the original methanol car, were replaced with standard Cadillac high flow injectors. These worked well although machining of the fuel rail injector brackets was necessary to insure a proper fit. The original, custom-made injectors were no longer usable because of intractable clogging of the parts.

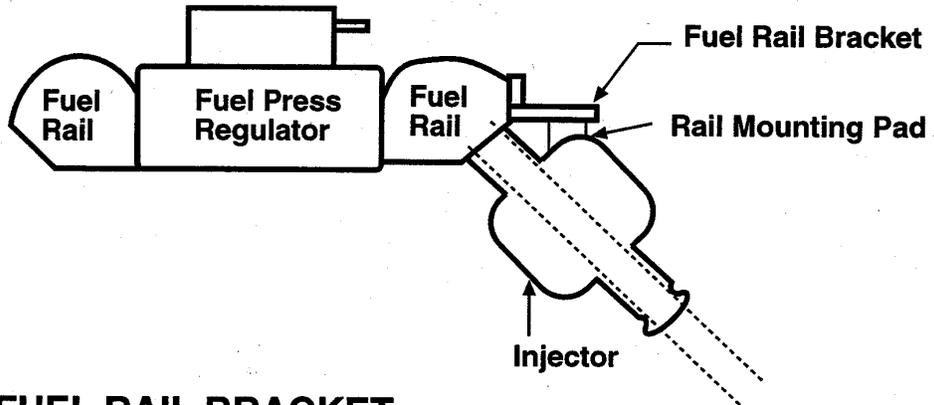
The Corsica became operational and the newly installed starting system allowed instantaneous cold starting.

This starting system may be particularly useful in the southeast where the standard M-85 fuel may be problematic. M-85 tends to separate in the high humidity conditions encountered most of the year in the southeast. Also, since the number of cold days in this region is much less than north of Florida, the starting system and fluid should last much longer.

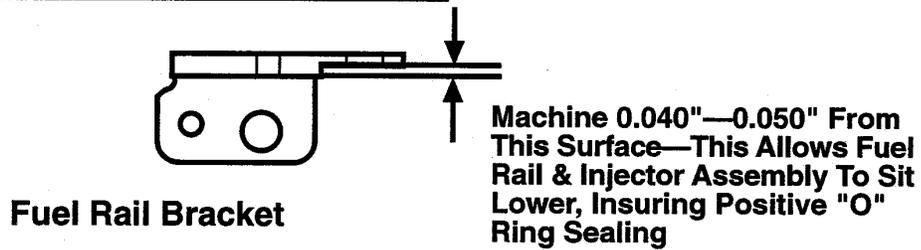
A new set of custom injectors for the bus were received from Roy's Diesel in Jacksonville.

# FUEL INJECTORS

## STANDARD CONFIGURATION

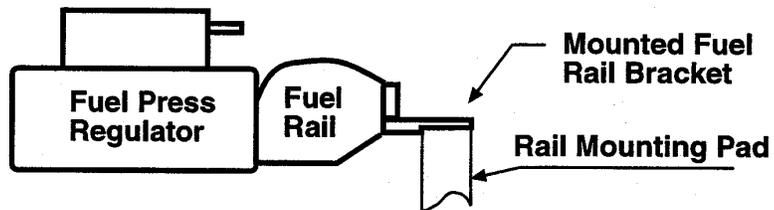


## MODIFIED FUEL RAIL BRACKET



## NEW INSTALLATION

Fuel Rail Assembly ~ 0.040" — 0.050" Lower



**INSTRUCTIONS  
DIESEL STARTING SYSTEMS  
A ZERO START  
COLD WEATHER AID  
FOR QUICK STARTS**

Starting Procedure

Electric Systems

**CAUTION:**

Inject Starting Fluid only while cranking engine.  
Use only for starting.

1. Start cranking engine.
2. Activate system – press switch.
3. Release - Injecting starting fluid to engine.

If engine fails to start repeat 2 and 3

**IMPORTANT:** Read all instructions and cylinder label before installing and using system.  
Read “Danger” on page 14.

**E-Z MOUNT VALVE INSTALLATION**

**VALVE LOCATION**

The valve should be mounted on the outside of the cab wall, firewall, any main frame member, radiator frame, hood side, or other similar location. A metal plate can be used to mount the system to the frame when a convenient location is not available. The valve should be mounted within 48” of the atomizer location and may be mounted at any angle within 20 degrees of vertical. After holes have been marked and drilled, mount the valve. Use 5/16” screws and nuts with lock washers to secure the valve to the mounting surface.

**DO NOT MOUNT VALVE**

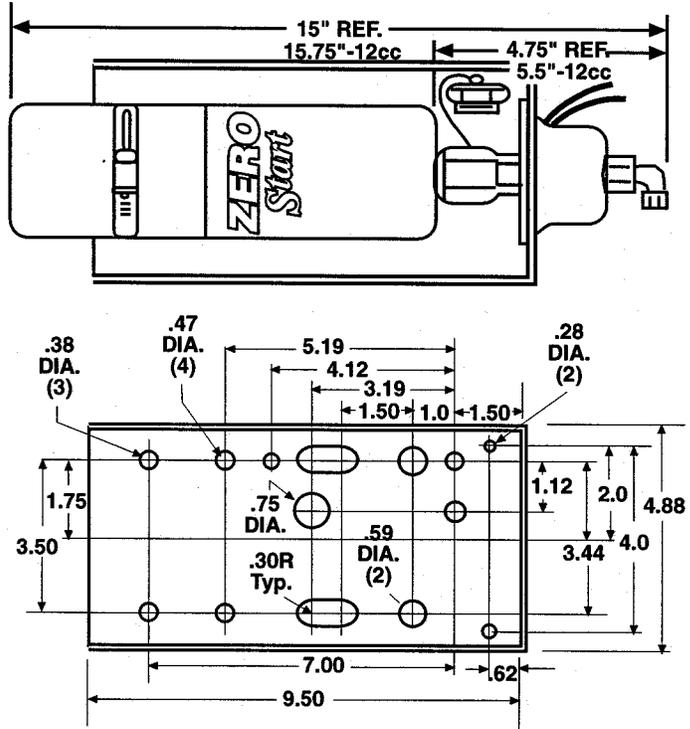
1. In the operator’s cab
2. Next to the exhaust manifold or any area where temperature may reach 160 degrees or above.
3. Where it is subjected to road dirt, ice, snow, etc.

**VALVE MOUNTING**

After location is selected, screw cylinder onto valve and hold in place to determine if you will have enough clearance to remove the fuel cylinder after valve is installed so replacement of a new cylinder is possible. Remove fuel cylinder and set aside while mounting valve to avoid accidental discharge of fuel. Put on dust cap to keep foreign matter out of valve.

Hole spacing for mounting purposes is shown. The E-Z Mount valve (without cylinder installed) can be used as a template to mark the desired hole locations. It is best to mount the valve with four screws. Avoid twisting or distorting the valve when the mounting bolts are tightened. (See page 9)

After holes have been marked and drilled, mount the valve. Use 5/16" screws and nuts with lock washers to secure the valve to the mounting surface.



## WIRING ELECTRICAL SYSTEM

SEE WIRING DIAGRAMS ON FOLLOWING PAGE

### WIRING:

For wiring the valve use No. 18 gauge or heavier, flexible braided or stranded wire, with insulation impervious to oil, grease and other engine or road dirt. (If leads are over 6 ft. you must use heavier gauge wire. Follow SAE suggestions).

**DANGER: ALWAYS REMOVE FUEL CYLINDER WHEN WIRING VALVE OR CHECKING WIRING SYSTEM. READ "DANGER" ON PAGE 14.**

Install the Push Button switch in a convenient location to the operator.

Using the blue three-way splice furnished, connect a wire between any wire connected to the "run" position of the ignition switch and either terminal of the Push Button switch.

Use the small terminals furnished to connect the wires to the Push Button switch and use the splices to connect the wires from the switch and the Thermoswitch to the valve leads.

### WITH THERMOSWITCH

Connect one wire of the Thermoswitch to the other valve using the splices provided. The remaining Thermoswitch should be grounded. This can be done by installing the lag terminal to the wire and putting it under the Thermoswitch mounting bolt.

### WITHOUT THERMOSWITCH

Install the large terminal to the other valve wire and place under one of the valve mounting bolts or to another convenient grounding location.

### TESTING:

Turn ignition switch on, push the Push Button switch. Plunger at top of valve should move up. When the switch is released, plunger should go down.

The valve is now ready to operate.

If unit fails to operate. Refer to "Troubleshooting Procedure" on page 14.

## TUBING INSTALLATION

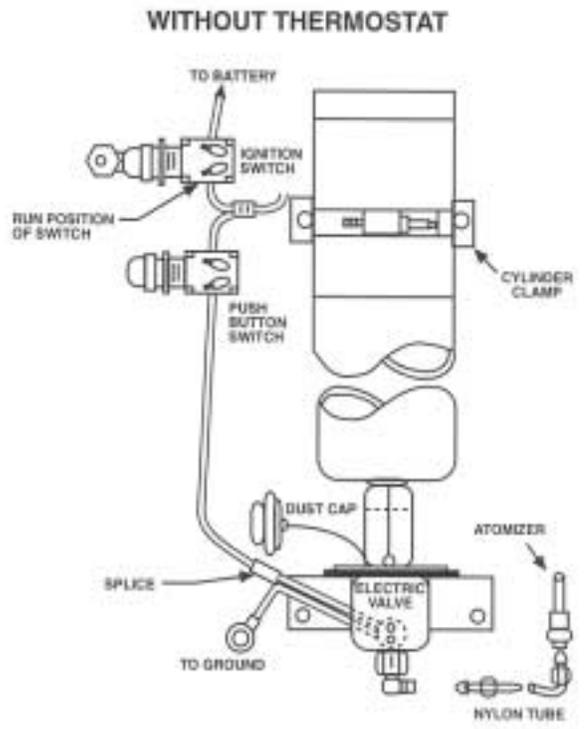
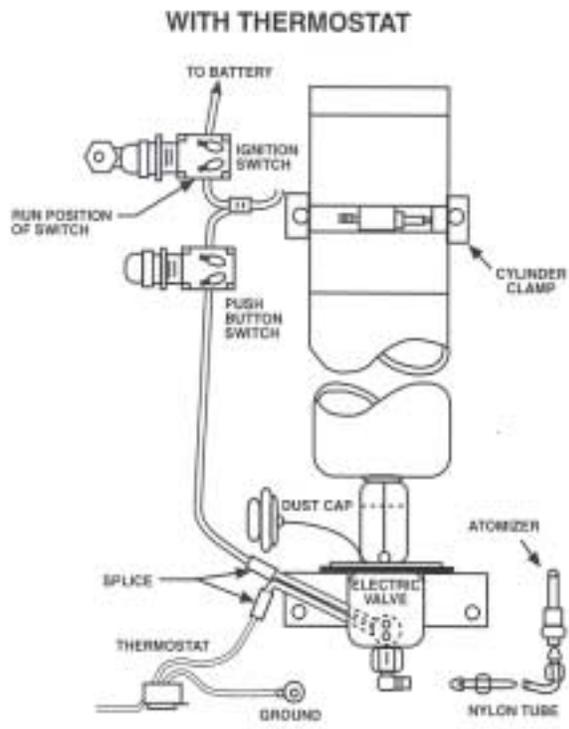
### LOCATION:

**IMPORTANT:** Route the tubing so that it does not contact hot exhaust manifolds or areas where it may be damaged by mechanical action or vibration. Also avoid possible kinking of the tube.

The tubing should be cut to as short a length as possible to accomplish best operation and installation

### INSTALLATION:

When connecting the tubing to the valve and atomizer fittings, be certain to keep the tubing fully seated while tightening the nut. Tighten nuts 1 to 1-1/4 turns with a wrench, after running down finger tight (20 to 30 in. lbs. of torque).



**TUBING INSTALLATION**

## **THERMOSTAT INSTALLATION**

The Thermostat should be mounted where it can most easily sense the engine temperature, such as against the side of the engine block, preferably near a water jacket.

**WARNING:** Never mount the Thermostat against the exhaust manifold since temperatures are too high and will destroy the Thermostat.

Make sure that there is no air gap between the metal face of the unit and the engine.

### **WIRING:**

Wire one lead of the Thermostat to ground and the second lead to the valve (see wiring diagram).

### **TESTING:**

1. Read "DANGER" on page 14. While the engine is cold, before screwing the atomizer into the intake manifold: Ether test: Install the fuel cylinder on the valve, press the Push Button switch for two seconds and release; fuel should spray from the atomizer. If the first test is okay, go on to the second test.
2. Start the engine and leave it running. When the engine is up to operating temperature, press the Push Button switch. No fuel should spray from the atomizer because the Thermostat opens the electric circuit, causing the valve to become inoperative.
3. After the unit tests properly, install the atomizer in the proper location. (See atomizer installation).

## **ATOMIZER LOCATION AND INSTALLATION**

### **LOCATION OF THE ATOMIZER**

The location of the atomizer in the air intake system is a most important consideration. We recommend that, on naturally aspirated engines, it be located between the air cleaner and the intake manifold. On turbocharged engines, the atomizer should be between the turbo and the intake manifold with the spray pattern directed toward the turbocharger. The important thing is to get a good, even mixture to all cylinders. The atomizer should not be installed so that all the starting fluid flows to any cylinder directly. Engines can be damaged if an atomizer is installed in the wrong place.

Many diesel engine manufacturers are providing a pre-tapped hole for atomizer installation.

The three atomizers supplied with this kit are color coded so that the correct atomizer for a particular engine can be selected by referring to the chart shown.

### **ATOMIZER INSTALLATION**

A 1/8-27 NPT threaded hole is required for mounting the atomizer. If a larger threaded hole is provided, a reducing bushing will be required to reduce the hole size to 1/8 NPT. A 1/4 NPT to 1/8 bushing is furnished.

If no pre-tapped hole is available, determine the desired location for the atomizer and remove the engine part where the atomizer is to be located. Drill and tap a 1/8-27 NPT hole in the desired location.

Screw the atomizer into the hole and tighten to approximately 40 in. lbs. of torque. When side hole atomizers are installed, the painted punch mark indicates the orifice location to insure that the atomizer is aimed in the desired direction.

ATOMIZER SELECTOR			
COLOR CODE	YELLOW	RED	BLUE
<b>CATERPILLAR</b>			
3208, 1100 Series		X	
3306		X	
3406, 3408, 1593, D348			X
<b>CUMMINS</b>			
N-Series B55 CID		X	
10L	X		
K8 Series			X
V-8 903		X	
Other V-8's	X		
<b>DETROIT DIESEL</b>			
	air horn		blower box
4 & 6 Cyl. inline	X		X
6V-53 & -71		X	
6V & 8V 71 & 92			X
<b>I.H.</b>			
9.0L V8			X
466	X		

### ENGINE MANUFACTURERS PRETAPPED ATOMIZER LOCATIONS



#### BLUE ATOMIZER



#### RED AND YELLOW ATOMIZERS

## TROUBLESHOOTING PROCEDURE

### BEFORE PROCEEDING Read "DANGER" at top of page.

#### DANGER

WHEN MAINTAINING OR TROUBLESHOOTING THESE SYSTEMS, ALWAYS MAKE SURE THAT YOU ARE IN A WELL VENTILATED AREA AWAY FROM HEAT, OPEN FLAMES, OR SPARKS. WEAR GOGGLES WHEN TESTING TO AVOID EYE INJURY. MAKE SURE THAT OPENINGS OF THE VALVE, TUBE, OR ATOMIZER ARE POINTED AWAY FROM YOURSELF WHILE TESTING.

THE ETHYL ETHER USED IN THIS STARTING FUEL FOR THESE SYSTEMS IS EXTREMELY FLAMMABLE, TOXIC, HARMFUL, OR FATAL IF SWALLOWED. AVOID CONTACT WITH THE SKIN OR EYES AND BREATHING THE FUMES. IF SWALLOWED, DO NOT INDUCE VOMITING. CALL PHYSICIAN IMMEDIATELY.

IF FUEL ENTERS EYES OR FUMES IRRITATE EYES, THEY SHOULD BE WASHED WITH LARGE QUANTITIES OF CLEAN WATER FOR 15 MINUTES. A PHYSICIAN, PREFERABLY AN EYE SPECIALIST, SHOULD BE CONTACTED.

DO NOT STORE CYLINDERS IN TEMPERATURES ABOVE 160 DEGREES F. CONTENTS ARE UNDER PRESSURE. DO NOT INCINERATE, PUNCTURE. OR ATTEMPT TO REMOVE CENTER CORE VALVE OR SIDE SAFETY VALVE FROM CYLINDER.

CHECK THESE POINTS WHEN THE UNIT DOES NOT OPERATE CORRECTLY.

#### A. FUEL CYLINDER:

Check to see if cylinder is handtight and screwed all the way down. Check starting fluid supply (empty cylinder weight is approximately 16oz/453.6g; a FULL cylinder is approximately 33oz/935.6g).

If the cylinder is empty - replace. Securely tighten cylinder clamp after replacing cylinder.

**IMPORTANT - ALWAYS CHECK VALVE GASKET UNDER CYLINDER** (it is suggested to replace gasket when changing fuel cylinders). IF GASKET IS DAMAGED OR MISSING, THE VALVE WILL LEAK WHEN OPERATED. REPLACE WITH NEW GASKET. IF TWO GASKETS ARE USED, THE VALVE MAY NOT OPERATE. (Gasket No. 320-3903).

ALWAYS CLEAN DIRT AWAY FROM THE TOP AND EXTERIOR OF THE VALVE BEFORE REMOVING CYLINDERS AND CLEAN OUT VALVE AREA WHERE CYLINDER IS INSTALLED SINCE ANY DIRT OR FOREIGN MATTER CAN CLOG THE VALVE OR ATOMIZER OR YOUR SYSTEM.

After checking all other components of the system in accordance with the listed troubleshooting points, if the cause of the inoperative condition still is not discovered, check the cylinder to determine if it has pressure.

#### B. ATOMIZERS:

**IMPORTANT:** Atomizer or Orifice clogging is a common cause for failure of a system and occurs because dirt has been allowed to get into the valve when changing fuel cylinders.

To check atomizer, remove from engine and activate the system. If no fuel sprays out of the atomizer, disconnect it from the tubing. Activate system. If fuel flows out of the tubing, atomizer must be replaced.

#### C. TUBING:

If fuel has not flowed out of the end of the tubing after removing the atomizer, disconnect the tubing from the valve and reactivate system. If fuel flows out of the valve, the tubing is obstructed and should be replaced.

#### D. MECHANICAL VALVE:

Activate valve by moving lever or knob up and then down. If no fuel is dispensed the valve is clogged or damaged. Replace valve.

If valve operates, check control cable for damage and wire stop screw for tightness.

#### E. ELECTRIC VALVE:

**NOTE:** NEVER hold the Push Button switch in for more than 5 seconds, as this can damage the electric valve solenoid. Activate valve by turning ignition switch on and pressing and releasing the Push Button switch. If no fuel is dispensed, remove fuel cylinder.

1. Activate valve. Plunger should move up and stay up until the Push Button switch is released. Valve is operative if plunger responds correctly. Go on to "F".
2. If plunger does not move up:
  - A. Jump the Push Button switch. If valve is operative, switch is defective and should be replaced. Go on to "F".
  - B. If no Thermostat is used, go on to "C". Short out the Thermostat using a jumper wire. If the valve operates, the Thermostat is defective and should be replaced.
  - C. If after jumping the Push Button switch, and the Thermostat if used, the valve is not operative, check wiring for continuity.
  - D. If the valve is still inoperative, replace it.

#### F. REASSEMBLY:

After correcting the problem, reinstall tubing and atomizer. Double check to see that all fittings have been replaced properly and are tight.

#### PREVENTATIVE MAINTENANCE

Take every precaution to avoid getting dirt inside top of valve, since this can get into valve chamber causing a clogged valve or atomizer. Refer to "Troubleshooting" Point "A" before replacing empty cylinders.

Check fittings for leaks.

Check all mounting bolts to make sure that they have not loosened. Periodically test unit for proper operation by following the steps recommended in the "Troubleshooting Procedures".

## **SECOND QUARTER**

### **1. Introduction**

During the second quarter of the period, the methanol car was re-commissioned and the operator, Dr. John Thomas, drove the car on a routine basis between 3325 W. New Haven Ave. and the Florida Tech main campus at 150 W. University Blvd. (please see Appendix). The operator also drove the car between his home and the above addresses. Before and after these trips, all gauge readings, the date, the time, and any comments were recorded. This allowed several mileage calculations. The gear shift did not work properly from the beginning and eventually stopped functioning at all. The problem was evidently caused by student modification of a key bearing done some nine years ago. The problem was easily repaired. The vehicle's mileage rate had dropped dramatically when the gear shift was operating at its poorest. The electronic temperature gauge was replaced with a mechanical one that allowed recording of the exact temperature in degrees F. The car is now operating at highest expectations.

The bus required more extensive work. It is now operating on methanol that was put in its tanks five years ago. According to fleet trial consultants, the vehicle is running as well as can be expected.

## **2. Activities (as recorded by the staff):**

1. To use cold start:

1<sup>st</sup> – try to start the car, if it does not start, then –

2<sup>nd</sup> – stop cranking the engine but leave the key on, and press the injector switch in until it clicks. The switch is located on the underside of the dashboard near the radio.

3<sup>rd</sup> – try to start the engine by normal starting procedures.

4<sup>th</sup> – if the engine does not start, repeat steps 2 and 3.

2. The Corsica's shift cable was replaced as it was found to be very hard to shift after warming up. Shifting was still unacceptable after replacing the shift cable.
3. The clutch pedal only disengages in the last inch or so of travel. This resulted in hard shifting.
4. The car was taken to Jim Rathmann's for repair.
5. Starting fluid was used to help start the bus. It idled well enough, but would not rev.
6. The bus is missing very badly when running or idling. Dirt in the fuel or old fuel is suspected. Recently installed injectors may already be clogged due to sediments in the lines. Further testing is indicated.
7. The bus started again, using starting fluid, after the governor and other controls were readjusted and freed up. The oil was also changed. Controls worked erratically at first; after familiarization they worked well.
8. Two clogged injectors on the bus required replacing. Warm-up to smooth operation took about 20 – 25 minutes. Achieving a certain temperature was necessary before revving the engine was possible. White smoke was emitted until warm up was achieved and all condensation from system had been burned off.
9. Driving on I-95 was used to test the bus' performance. It operated well, but is not really designed for highway use due its to low gear ratio. The bus's maximum speed was about 55 mph.
10. An inspection of the Corsica transmission was performed, as a bad clutch was suspected. The clutch was fine; however, the clutch-engaging arm and bearings were bad, resulting in the clutch not fully engaging. The problem was fixed and the car is now running well.
11. An air leak in the bus was fixed, and all panels were put back on and tightened down. Bus graffiti was removed.

12. Several cleaning materials were tried on the seats. Most either had no result or began eating or rubbing off the covers.
13. Throwout bearings in the transmission were replaced in the Corsica, along with a clutch fork arm and the bushings. The play resulting from worn bearings prevented the clutch from fully disengaging and resulted in difficult shifting. Alternative Automotive in West Melbourne performed the transmission repairs.
14. Modifications to both vehicles for on-board emission samplings were discussed and designed.
15. The Corsica air-conditioner was inspected for leaks.
16. An ether start system was installed in the bus identical to the one installed in the Corsica, as detailed in the last quarterly report. After installation, only a few minutes were required for the bus to properly warm up.

### **3. Results and Discussion**

The methanol-powered car was operated routinely; the total miles traveled after re-commissioning were 1,176 over approximately 3 months. Mileage varied from a high of 12.8 mpg to a low of 5.5 mpg. The low mileage data was obtained when the shifting problem was at its worst. A mechanical temperature gauge was installed which allowed detection of any overheating. The original electronic temperature gauge never worked well. All gauges (oil, fuel, and battery) now work well, and displayed only normal readings. The cold-starting system continues to work very well. Repairs were performed on the car because of a defect in the air conditioning system.

The bus operated satisfactorily, but was not driven routinely as its fuel shipment did not arrive. It did, however, make a 50-mile trip on I-95. An ethyl ether starting system was installed on the bus and worked very well. The same type of ether starting system was used on both vehicles.

Only lack of familiarization caused any problems with putting the bus into operation. Two clogged injectors were replaced. The bus was also modified to allow on-board collection of emission data. Preliminary results concerning sampling techniques for emission testing were very encouraging.

The Corsica performed much better after repairing the air conditioning system and electronic control module (ECM). In-traffic mileage was 9.1 mpg, and highway mileage was 11.92 mpg.

The bus was made completely operational during this period, and routing trips to the Harbor Branch Oceanographic Institute (HBOI) just south of Vero Beach (50 miles distant); were begun. Any failures in bus performance to date have been caused by bad injectors, bad solenoids, and bad vacuum lines. No problems caused by the methanol fuel or the Avocet additive have yet occurred.

## **THIRD QUARTER**

### **1. Introduction**

During this period, the Corsica was routinely driven between 3325 W. New Haven Avenue and the Florida Tech main campus at 150 W. University Blvd., as well as to other locations in and around Melbourne and Palm Bay (see Appendix). All gauge readings were recorded before and after each trip, allowing several mileage calculations. As the summer approached, it became very necessary to repair the air conditioning system. GM was contacted and forwarded a wiring diagram to the fleet trial team. The vehicle was also modified to allow on-board collection of emission data. Preliminary results concerning sampling techniques for emission testing were very encouraging.

The bus was made completely operational during this period, and routine trips were made to the Harbor Branch Oceanographic Institute (HBOI) just south of Vero Beach, a distance of 50 miles. All failures in bus performance to this point were caused by bad injectors, bad solenoids, and bad vacuum lines. No problems have yet occurred that were caused by the methanol fuel or the Avocet additive. An adapter for emissions testing was placed on the vertical exhaust pipe from inside the bus.

## 2. Activities – Methanol Car

1. A commercial cold start ether injection system was purchased for \$110.51. The cold start system was installed and appears to have made a big difference in starting.
2. The ECM was found to be non-functional and was removed. It was modified from the original, therefore a new one should be installed. A decal contract for bus and car signage was awarded.
3. Decals were applied to both vehicles.
4. A new ECM was installed and prom with standard equipment.
5. Trouble codes 32 and 41 continuously popped. Five new coil packs, one ignition module, spark plugs and spark plug wires, a new MAP sensor, and a new crank sensor were installed. Replacement of the ECM eliminated the code 32 problem, but the code 41 problem continued. Code 41 refers to Electronic Spark Timing (EST).
6. It was determined that wires going to the ECM had been spliced and excessive corrosion had built up on the splice. The splice was cut out and resoldered, properly eliminating a “magic” black box, removed because it was extraneous. This solved the code 41 problem. The car ran considerably better from this point forward.
7. A warm A/C complaint was made, and a bad cooling fan compression switch was diagnosed. A new one was bought from Rathmann’s and installed. Approximately 1 lb. of Freon was added to optimize cooling. The system began working properly.
8. A hole was cut in the bottom of the trunk of the car to allow room to install coupling for emissions analyses. The coupling was welded into the exhaust pipe and a plug was installed to seal up the hole until emissions testing was in operation. Rubber tubing was inserted all the way around the lip of the hole to seal it. A trap door was then pop-riveted to the floor to close up the hole in the floor.
9. A modified brake line with brass fittings was made for taking samples. It was installed into the exhaust system and tightened down to the coupling welded into the pipe.

## METHANOL BUS OPERATION DATA

### Procedure for starting the methanol bus:

Prior to engaging the engine the bus is switched to the daytime running position. Upon activating this switch, the air pump turns on, filling the air brakes and door activator. Then, the engine can be turned over. This is accomplished by pulling a switch in the rear of the bus. However, due to the cold weather in the winter, the bus was equipped with an ether injection system to help the engine to turn over. On average, it takes about 5 to 10 tries to successfully start the engine with this injection system. However, with an addition of methanol additive (Avocet) to the fuel (3%), engine turnover is sometimes reduced to 2 - 5 attempts. After the engine has been successfully started, the high idle switch is engaged to decrease the warm-up time. The engine is warmed up to 180 degrees before attempting to move the bus. The average warm up time is 20 to 40 minutes. The bus will run very roughly if the engine is not at 180 degrees. After this initial warm up period, the bus can be run all day without problems.

- ▶▶ 5/19/98: 110 gallons of fuel were added. The bus was driven to BioWest and back. Thirty-five minutes of warm-up time were needed.
- ▶▶ 5/21/98: A special valve adaptation was made for the methanol drums. Small air leaks in the front were repaired

Starting mileage - 14514  
Ending mileage - 14527  
13 miles (30-minute drive)

3 gallons of additive were added.

- ▶▶ 5/26/98: A radio was added. The battery terminals were cleaned and polished. The bus was driven to BioWest to stay.  
Starting temperature - 170°  
Starting mileage - 14527  
Ending mileage - 14531  
4 miles (15 minutes)

- ▶▶ 5/27/98: MeOH was added (50 gallons). The tank was filled and one gallon of Avocet additive was added. The bus was driven locally, from N. Wickham Road by 95 S to BioWest.

Starting temperature - 180°  
Starting mileage - 14531.2  
Ending mileage - 14556.9  
25.6 miles (1-hour drive)

- ▶▶ 5/29/98: The vehicle may need oil soon, as the pre-trip inspection revealed the oil to be low on the dipstick. Two gallons of oil were added. New windshield wipers were also needed. The vehicle was driven to FIT by way of: The bus was driven from the Brevard Teaching and Research Lab (BTR) in Palm Bay via 95N and Wickham Road to BioWest.

- ▶▶ 6/1/98: The bus was taken from BioWest to the FIT campus to investigate an engine problem. The problem was unsolved due to lack of experience with this type of engine. It may be a vacuum leak. The bus was then driven back to BioWest.

Starting mileage - 14599.3  
Ending mileage - 14611.2  
11.9 miles

- ▶▶ 6/16/98: The engine problem was repaired, and the vehicle was made ready to take to Harbor Branch Oceanographic Institute (HBOI), just south of Vero Beach.

- ▶▶ 6/17/98: The bus was taken on a test run to HBOI. Beginning tomorrow, HBOI will be a daily trip.

Starting mileage - 14611.5  
Ending mileage - 14704.4  
92.9 miles

The bus was driven on Babcock to US-1 (S) to HBOI and the return. Twenty-seven and one-half gallons of MeOH were added.

- ▶▶ 6/19/98: The bus was driven to HBOI. This time the route taken was via I-95, to HBOI and back.

Ending mileage - 14799.5  
Starting mileage - 14704.4  
95.1 miles

The bus ran fine there and back. A 23-minute warm-up period was required.

- ▶▶ 6/22/98: The bus was driven to HBOI and back. Fifty-five gallons of fuel were added.

Ending mileage - 14895.6  
Starting mileage - 14799.5  
96.1 miles

A 23-minute warm up was required. The bus ran terribly on the return trip.

▶▶ 6/23/98: Fifty-five gallons methanol and three gallons of additive were added. A 20-minute warm-up was necessary.

▶▶ 6/25/98: The bus was driven to HBOI and back.

Ending mileage -	14995.6
Starting mileage	<u>14895.6</u>
	100.0 miles

It was noticed that the governor is not consistently taking over anymore; however, it picked up later on. The bus ran very well with a 20-minute warm-up. Fifty-five gallons of fuel and two gallons of additive were added. A 19-minute warm-up was allowed.

▶▶ 6/29/98: The bus was driven to HBOI and back.

Ending mileage -	15096.1
Starting mileage-	<u>14995.6</u>
	100.5 miles

The bus started on the 2<sup>nd</sup> try, which was very good. It ran well. Fifty-five gallons of fuel and two gallons of additive were put in. A 25-minute warm-up was necessary.

▶▶ 6/30/98: HBOI

Ending mileage -	N/A
Starting mileage -	<u>15096.1</u>

The bus broke down at HBOI. The bus required three attempts to start. A 20-minute warm-up time was required.

▶▶ 7/3/98: The bus was towed back to Melbourne by Lee's Wrecking.

▶▶ 7/10/98: The bus was returned to operating condition. The cause of the breakdown was a faulty fuel injector.

### **3. Results and Discussion**

The methanol-powered car continued operating routinely and the total miles traveled since re-commissioning are 2,060 miles over approximately six months. The mileage ranged from a high of 11.92 mpg (highway) to a low of 9.0 mpg (city driving). All gauges are functioning well and no unusual readings have been observed. The air-conditioning system was repaired and operated normally. The cold-starting system worked well. The only current repair requirement is for dash lighting, expected to be completed soon. Installation of the on-board emission measuring systems were completed for both the car and the bus.

The methanol powered bus was recommissioned and made several trips in the Melbourne area. It also made five trips (500 miles) to the Harbor Branch Oceanographic Institute (HBOI) just south of Vero Beach. The ethyl ether starting system worked very well, but was becoming unnecessary due to the use of fresh Avocet ignition enhancer (3%) and warmer weather. The bus broke down at HBOI on the last trip. The cause of the breakdown was a faulty injector which was quickly replaced. The bus is again operational.

A preliminary car exhaust sample was submitted for analysis.

## **FOURTH QUARTER**

### **1. Introduction**

During this very active period, FIT received a '93 Flexible-Fueled Ford Taurus as a donation from the Ford Motor Co. This vehicle can operate on any fuel mixture containing gasoline and methanol. The vehicle has digital displays of percent methanol, distance to empty, average fuel mileage, bar display fuel gauge, and miles elapsed. These data were recorded on a routine basis while driving the vehicle between 419 Bridgetown Court and 3325 West New Haven Avenue, and to and from other locations.

The primary purpose of acquiring this vehicle was to compare its performance with that of the Chevrolet Corsica which is being run on M-100. Previous negative performance with M-85 in 1989 and 1990 at Florida Tech caused concern over whether M-85 could perform in the high heat and humidity common to this area.

No vehicle upgrades or repairs were necessary after acquiring the Taurus.

The Chevrolet Corsica was also run extensively during this period, but it required air conditioning repairs by Alternative Automotive. It now requires a new compressor. Nevertheless, the vehicle was in operation very regularly.

The Blitz bus was not operated much during this quarter as funds required to pay a bus driver had been exhausted.

All vehicles using methanol fuels performed well during this period. No vehicle operational problems encountered were caused by the use of methanol fuel.

First emissions analyses were obtained by using on-board systems.

## **2. Activities: Methanol Car**

1. The car was sent to Alternative Automotive to repair wiring needed for the main cooling fan and the air conditioner.
2. The air conditioner failed again and a new compressor was required.
3. Analytical samples were taken from previously described sample ports in both the Corsica and the bus. Exhaust samples were taken in specially prepared bags supplied by BTR. One bag was used for each speed range. Once the bags were filled with exhaust gas, they were sealed and removed from the sampling port. After all the bags were collected, they were delivered to BTR and assayed for methanol, NO<sub>x</sub>, and formaldehyde. The preliminary results from BTR are shown in Tables 1 and 2.

### 3. Results and Discussion

The Flexible Fueled Taurus was driven a total of 5,092.9 miles since it was acquired by Florida Tech on July 15, 1998. The vehicle was driven, using gasoline, from Dearborn, MI to Melbourne, FL, a distance of 1,231.9 miles. Thus, the vehicle has been run on a routine experimental basis using methanol-gasoline formulations, for a total of 3,861.0 miles. Highway mileage when using gasoline is 29 mpg while city mileage using gasoline is 18.9 mpg. Mileage data acquisition for the various methanol-gasoline formulations has been complicated by either one or a combination of factors which could include:

- ▶▶ layering of the formulation in the holding drum;
- ▶▶ layering of the formulation in the car's tank;
- ▶▶ a possible faulty meter on the fuel pump.

All these possibilities are being addressed and better data should soon be acquired.

The police of Collier County (Naples) Florida acquired 25 of the same type '93 vehicles from Ford in 1996. So far, two of these vehicles are now inoperable due to bad sensors which cost \$2,400 to replace.

The Corsica was driven a total of 584 miles, mostly between 3325 West New Haven and Florida Tech's main campus. The car performed very well at all times, save for the air conditioning problem. Mileage remained at essentially 9.0 mpg for city driving. A metered pump was built by Florida Tech to pump M-100 directly from the methanol drum into the car.

As mentioned previously, exhaust samples were taken from the bus and the car, and showed some surprising results. The NO<sub>x</sub> results in the car appear reasonable. The NO<sub>x</sub> and formaldehyde results from the bus also appear reasonable, in view of the fact that the samples were taken from the

mid-point of the vertical tailpipe. At this point in the tailpipe, the heat is very high, resulting in higher values for NO<sub>x</sub> and formaldehyde. All the methanol results appear lower than expected.

In addition to the work reported, all work scheduled for the fourth quarter was completed except for the CO and CO<sub>2</sub> analyses, which could not be accomplished, as the instrument needed repair. Bus mileage for city driving was found to be 1.33 mpg and the highway mileage was found to be 1.28 mpg. Dash lights repairs were made to the car and dash lights now perform well.

**Table 1**

**Preliminary Emissions (ppm) for the 1988 Chevrolet Corsica**

<b><u>Speed (mph)</u></b>	<b><u>Methanol</u></b>	<b><u>NO<sub>x</sub></u></b>	<b><u>Formaldehyde</u></b>
0 - 10	0.16	100.3	0
10 - 20	0.15	105.5	0
20 - 30	0.15	91.5	0
30 - 40	0.15	20.5	0
40 - 50	0.14	8.8	0
50 - 60	0.15	24.1	1.6

**Table 2**

**Preliminary Emissions (ppm) for the Blitz Bus**

<u>Speed (mph)</u>	<u>Methanol</u>	<u>NO<sub>x</sub></u>	<u>Formaldehyde</u>
0 - 10	0.22	220.5	15.7
10 - 20	0.15	214.5	15.8
20 - 30	0.54	208.5	28.1
30 - 40	0.14	131.0	21.0
40 - 50	0.13	146.0	15.3
50 - 60	0.00	123.5	31.5

## **FIFTH QUARTER**

### **1. Introduction**

During this active period, the Ford Taurus and the Chevrolet Corsica were routinely operated. Both vehicles performed excellently after repairs were made. The fuel dispensing system for the vehicles was repaired and the pump was used to dispense methanol quickly into the receiving containers. The receiving containers were calibrated with accurately measured volumetric flasks and were found to be accurate as marked by the manufacturers.

The Blitz bus was not operated during this quarter because of a fuel line leak which will require extensive repair and because we lack funds for payment of a bus driver.

The Ford Taurus was run on varying percentages of methanol ranging from M-70 to M-15. All combinations performed well. It was noted that in all cases the mpg actually measured were greater than the theoretical mpg.

The Chevrolet Corsica was run on M-100, as usual, with the ethyl ether cold start system.

**2. Activities:**

1. The Chevrolet Corsica was dispatched to Alternative Automotive to replace the air-conditioner compressor and to change over to the new EPA approved refrigerant,134R.
2. The Ford Taurus was fitted with a new oil filter. The old one was split and this caused a massive oil leak in October which prevented driving the vehicle to Morgantown for the presentation.

### 3. Results and Discussion

The Flexible-Fueled Taurus has been driven a total of 6,469.7 miles on methanol fuels since Florida Tech took possession of the vehicle on July 16, 1998. Ford Motor Company drove the Taurus for 41,690.3 miles prior to Florida Tech taking possession of it. Hence, the vehicle has been driven successfully on methanol-gasoline formulations for a total of 49,755.9 miles.

The 1988 Chevrolet Corsica has now been driven a total of 10,323 miles on M-85 and M-100 formulations. The majority of these miles were driven in 1989 and 1990 for the methanol fuel student competitions. For the period of Jan. 6, 1998 – Jan. 7, 1999, the vehicle was driven 3,376.5 miles. Mileage for this reporting period is as follows:

Chevrolet Corsica:	561.5 miles
Ford Taurus:	2717.2 miles

The Ford Taurus has now been run on the following formulations: M-85, M-70, M-55, M-40, M-25, and M-15. All calculated mileages have been greater than theoretical mileages. Any doubtful runs are being currently repeated. Vigorous stirring with a 5 feet X 1 inch dowel is done to prevent layering in the drum. All fuel volumes used have been calibrated against rigorously measured volumetric flasks. The digital readout mileage display is not working at all at this time; however, the car performs well at all listed methanol levels.

## **SIXTH QUARTER**

### **1. Introduction**

This quarter was particularly active. The Ford and the Chevrolet were driven extensively but both developed fuel pump problems. These problems were expected and fixes have been readied. Unfortunately, lack of funds has forced us to operate the vehicles until the fuel pumps fail completely prior to repairing them.

Two applications for additional funds were submitted to the Florida Solar Energy Center and the Florida Energy Office, respectively. The support letter provided by Air Products was very helpful in these applications.

This report not only covers the previous quarter's activity, but also compiles a great deal of data obtained over the length of the contract. These data were compiled at this time to insure no readily obtainable data would be inadvertently omitted from the final report.

## 2. Activities

Activities included driving the two vehicles and attending to the events listed below.

<b>Date</b>	<b>Vehicle</b>	<b>Event</b>
1/28/99	Ford	Bad hum first noticed.
1/15/99	Corsica	Vehicle would not start.
1/16/99	Corsica	Vehicle taken to Alternative Automotive where fuel pump was replaced with conventional fuel pump.
2/5/99	Corsica	Coolant temperature rose to 223° and AC stopped. Vehicle taken to Alternative Automotive to repair AC wiring to main cooling fan. Also Schrader valve in engine failed and methanol flooded engine <u>but did not burn</u> .
2/8/99	Ford	Vehicle taken to Alternative Automotive where it was determined the fuel pump was the problem.
3/24/99	Corsica	Noticed bad hum in car. FIT thought it was a fuel pump problem.
3/31/99	Corsica	Encountered difficulty starting car.

### **3. Results and Discussion**

The '88 Chevrolet Corsica and the '93 Ford Taurus Flexible Fueled Vehicle were extensively operated during this period. The Corsica was driven 1,078 miles and the Ford was driven 1,904.4 miles. The Corsica has now been driven a total of 11,384.1 miles on M-85 and M-100 fuels and the Ford has been driven a total of 51,305 miles on various percentages of gasoline and methanol. However, as expected, both vehicles developed serious fuel pump problems. The Ford fuel pump could be replaced by a new one costing \$1,320. This large expense will be deferred until new grants or contracts are received. The Ford engineer recommended that in the meantime we run the vehicle until it quits entirely. The principal symptom of the bad fuel pump was a loud, annoying hum.

The Corsica also developed a bad fuel pump but the only symptom was a complete failure to start. The pump was replaced with a new fuel pump used in standard gasoline powered cars. This strategy was based on the fact that the previous conventional fuel pump operated for a year. Inquiries were also made regarding the availability of methanol resistant fuel pumps from General Motors. Apparently, these are spare methanol resistant fuel pumps available from a previous Lumina program that existed in the early nineties. The failed conventional fuel pump was disassembled. There was no damage found except for a corroded electrode.

The following section contains a compilation and summation of important data obtained over the entire period of the contract to this point. This compilation was performed to insure that no easily obtained data points have been inadvertently omitted. Parts cost and outside services data for the bus and the two cars, as well as mileage data for the two cars are included.

**Cost of Parts and Outside Services  
For the Methanol Bus and Two Methanol Cars**

<b>Date</b>	<b>Cost</b>	<b>Item</b>	<b>Labor</b>
09/25/97	3.34	Starter Fluid	
09/30/97	80.90	Batteries	
10/10/97	224.90	Batteries	
10/14/97	4.49	Fuel Filter	
10/14/97	8.34	Fuel Filter	
10/15/97	35.00	Towing	
10/16/97	7.15	Fuel Filter	
10/16/97	171.57	Water Pump	
10/16/97	6.23	Fuel Filter	
10/16/97	82.19	Sensor	
10/18/97	20.85	Hose End	
10/19/97	12.71	Hose End	
10/27/97	21.24	Carburator Cleaner	
10/30/97	330.78	8 Injectors	
10/31/97	12.25	Adhesive Remover	
11/06/97	30.56	Valve	
11/07/97	24.50	Adhesive Remover	
11/10/97	300.00	Bus Tow to FIT	
11/19/97	18.69	Conversion Kit	
11/19/97	120.00	Tailpipe	
11/19/97	8.18	Fuel Filter	
11/20/97	18.69	Conversion Kit	
11/20/97	89.88	Hose Ends	
11/20/97	7.88	Hose	
11/20/97	7.38	Hose	
11/20/97	8.97	Hose End	
11/20/97	8.86	Hose End	
11/20/97	8.89	Hose End	
11/20/97	8.86	Hose End	
11/24/97	16.00	Fuel-line Hose	
11/25/97	755.00	Body Work and Painting of Car	
11/25/97	124.99	DL Gold Alternator	
12/09/97	5.30	Ins. For Diesel Injector Delivery	
12/09/97	9.04	Wiper Blade	
12/11/97	214.52	4 New Tires and Installation	
12/11/97	10.73	ECH Sensor	
12/15/97	55.39	Sender	
12/17/97	952.44	Diesel Injectors	
12/18/97	3.51	MT Kit	
12/18/97	12.41	Cylinder	
12/18/97	97.09	Starter Kit	
12/19/97	14.00	Tubing	
01/20/98	26.84	Cylinder	
02/12/98	210.00	Clutch Kit Flywheel Turned	230

02/16/98	60.99	Throttle Cable (Bus)	
02/16/98	131.27	Replace Clutch Fork Arm, Bushing, Throw-out Bearing	269
02/23/98		Diesel Consultant	1,400
03/03/98	5.67	Transmission Filter	
03/09/98	9.98	Halogen Headlamp	
03/10/98	7.68	Fitting	
03/10/98	30.82	Gauge	
03/11/98	8.07	Ring	
03/11/98	13.71	Hose	
03/11/98	13.63	Hose	
03/11/98	8.31	Adapter	
03/11/98	13.57	Hose	
03/16/98	9.05	Loom	
03/16/98	9.90	Palyloom	
03/16/98	0.40	Fitting	
03/23/98	2.13	T1 Shine	
04/06/98	97.09	Starter Kit	
04/06/98	13.42	Cylinder	
04/24/98		Sign painting for Car & Bus	525
04/29/98	37.65	M.A.P. Sensor	
05/04/98	105.31	ECH Computer	
05/04/98	195.00	ECH Computer	
05/06/98	120.27	ECH Module	
05/06/98	96.15	Ignition Coil	
05/10/98	12.47	Prom	
05/10/98	7.50	Plugs	
05/10/98	17.42	ECM	
05/19/98	43.95	Ball Valve	
05/19/98	1.74	Nipple	
05/29/98	13.45	Flare Kit	
06/02/98	43.49	First Aid Kit	
06/02/98	17.18	Wiper Blade	
06/02/98	5.28	Wiper Refill	
06/02/98		Diesel Consulting Services	500
06/03/98	14.69	Fan Switch	
06/03/98	30.00	Freon R-12	
06/03/98	14.69	Switch	
06/13/98		Diesel Consulting Services	280

**Totals (to the end of sixth quarter):**

Vehicle	Cost of Parts	Outside Labor Cost
1988 Chevrolet Corsica	\$ 3,723.98	\$ 499.00
Blitz Bus	\$ 1,590.76	\$ 2,180.00
1993 Ford Taurus FFV	\$ 0.00	\$ 0.00

**1988 Chevrolet Corsica**  
**M-100 Miles Per Gallon, Variance, and Standard Deviation**

Date	Miles Per Gallon	S	S <sup>2</sup>
01/26/98	12.80	1.92	3.69
01/28/98	11.64	0.76	0.58
01/29/98	11.27	0.39	0.15
03/03/98	9.28	1.60	2.56
03/18/98	10.00	0.88	0.77
03/19/98	11.48	0.60	0.86
03/25/98	9.85	1.03	1.06
06/04/98	10.50	0.38	0.14
06/05/98	9.16	1.72	2.96
06/10/98	11.92	0.04	0.00
06/17/98	9.00	1.88	3.53
06/22/98	8.91	1.97	3.88
07/07/98	8.84	2.04	4.16
08/25/98	11.05	0.17	0.03
08/26/98	10.33	0.55	0.30
08/27/98	11.24	0.36	0.13
12/09/98	10.61	0.27	0.07
12/14/98	11.72	0.84	0.71
12/17/98	12.07	1.19	1.42
12/18/98	11.96	1.08	1.17
12/21/98	10.81	0.07	0.00
12/22/98	11.30	0.42	0.18
01/12/99	10.61	0.27	0.07
01/13/99	11.25	0.37	0.14
01/14/99	12.50	1.62	2.62
02/24/99	12.70	1.82	3.31
03/08/99	10.46	0.42	0.18
03/09/99	11.22	0.34	0.12
03/15/99	10.42	0.46	0.21
03/18/99	11.24	0.36	0.13
03/22/99	10.74	0.14	0.02
03/23/99	11.46	0.58	0.34
Mean = 10.88		Total S <sup>2</sup> = 34.99	
N = 32		Total = 35.49	

Standard deviation is  $35.49/31 = 1.14$

This means that miles/gallon are  $10.88 \pm 2.28$ , 95% of the time. This is 14% greater than what would be calculated on the basis of BTU values alone.

## COMPARATIVE MILEAGE FOR THE '93 FORD TAURUS FFV

DATE	MPG CALC.	DISPLAY MPG	% MeOH ADDED	% MeOHact	DISPLAY % MeOH	MILES
07/30/98	--	18.9		0	0	43,858.6
08/31/98	--	13.6	85	67	85	44,095.4
09/17/98	15.71	14.7	55	58	65	45,842.6
09/22/98	16.46	14.7	55	55	65	46,126.8
10/30/98	18.59	17.4	40	40	35	47,456.2
11/05/98	17.04	16.8	40	40	35	47,773.1
11/11/98	18.46	16.9	25	23	35	48,112.5
11/19/98	19.53	17.4	25	25	25	48,507.2
12/02/98	19.77	17.6	15	25	0	48,865.3
12/23/98	19.81	17.6	15	15	0	49,227.7
01/06/99	18.23	17.8	15	15	25	49,562.3
01/15/99	12.82	17.5	85	77	85	49,768.4
01/28/99	12.26	16.3	85	85	85	50,388.2
02/02/99	13.43	16.0	85	85	85	50,615.6
02/04/99	14.86	15.9	84	85	85	50,973.4
03/25/99	12.25	15.7	70	73	85	51,057.6*
03/30/99	14.19	15.5	70	70	85	51,265.0
04/05/99	14.42	15.4	70	70	75	51,506.1

\* = after long period of inactivity

Average miles/gallon differential between that observed overall and that calculated on the basis of BTU alone is 15.82%.

Average miles/gallon differential between that observed with M-70 and that calculated on the basis of BTU alone is 15.85%.

Average miles/gallon differential between that observed with M-85 and that calculated on the basis of BTU alone is 23.70%.

## **SEVENTH QUARTER**

### **1. Introduction**

As mentioned in the previous quarterly report, both the Ford and the Chevrolet developed fuel pump problems; therefore, they were not operated due to lack of funds necessary for repair or replacement. The bus was also not operated because of fuel leaks which required stainless steel parts and skilled labor for repair.

However, the application submitted to the Florida Energy Office was rated number one by the review group. A contract between Florida Tech and the Florida Energy Office was executed on June 11<sup>th</sup> at a contracted amount of \$50,000. The bus fuel line leaks were repaired on June 28<sup>th</sup> and its faulty parts were replaced with stainless steel fittings.

A proposal was submitted to Air Products and Chemicals, Inc. concerning emissions analysis. Presentation materials requested by Mr. Heydorn were prepared and submitted. Mr. Heydorn will use these materials in an upcoming presentation before USDOE.

## **2. Activities**

Activities included driving the two vehicles and attending to the events listed below.

1. Routine operation of the Corsica was ended on 3/31/99 because of fuel pump problems.
2. Routine operation of the Ford FFV was ended on 4/7/99 due to fuel pump problems.
3. A proposal concerning emissions analysis for methanol vehicles was submitted to Air Products on 6/18/99.
4. Presentation materials requested by Mr. Heydorn were prepared and sent to him on 6/25/99.
5. The bus fuel line leaks were repaired on 6/28/99. The bus was started and brought to operational temperature in 20 minutes.

### **3. Results and Discussion**

As mentioned in the Introduction, few operational results were obtained in this quarter. However, as part of the proposal submitted to Air Products and Chemicals, Inc., an extensive literature search concerning emissions analyses for methanol vehicles was conducted. The method that was most popular among interested groups throughout the USA involved long path-length infrared spectrophotometry. Therefore, the proposal submitted was centered on this method.

The bus fuel line leaks were repaired and faulty parts were replaced with stainless steel fittings. The bus was started and brought to temperature in 20 minutes. It idled well. A driver will be obtained from Brevard County as soon as contractual arrangements with the County can be completed.

The precipitous failure of the fuel pumps prompted a call to engineers at Ford and at the California Energy Commission (CEC), who stated that the failure was probably caused by a methanol incompatible fuel dispensing system. Since a new mechanical dispensing pump had been introduced recently, it is assumed their assessment is correct.

A totally methanol-compatible fuel station is currently being built. The CEC is very helpful, but obtaining compatible parts is challenging. Any assistance from Air Products and Chemicals, Inc. would be welcome.

## **EIGHTH QUARTER**

### **1. Introduction**

During this period, an account was established to allow spending on the awarded state contract. This released funds needed to repair the leaks in the bus and to purchase and install fuel pumps for the two cars.

Stainless steel fittings were installed in the fuel lines of the bus which were closest to the fuel pump. These fittings are under greater pressure because of their proximity to the fuel pump.

The methanol resistant fuel pump was difficult to obtain as these were made only for the early nineties Lumina models. All metal parts appeared to be stainless steel. Nonetheless, a pump was obtained at an elevated, but reasonable, cost.

## 2. Activities

1. As mentioned previously, a leak had been discovered in the fuel system of the bus. It emanated from the fuel pump where the line was under high pressure. Other fittings near the pump looked fatigued and it appeared that they might crack or begin leaking in the near future. Greg Leonard, the diesel mechanic, was called to fix the leaking fittings. The leaking fittings were temporarily replaced with new brass ones and stainless steel replacements for all the fittings in the fuel pump compartment were investigated. The bus batteries were charged and the engine started. The engine started quickly after a few shots of ether were injected and after turning it over about three times. Due to the lack of funds for a driver, this was the first time it had been started in several months. It required 20 to 25 minutes to warm up.
2. The bus was started after the batteries were charged and it ran very well after warm-up to normal operating temperature.
3. New stainless steel fittings were installed in the fuel pump compartment. The old brass fittings were switched to stainless steel to prevent the breakdown of the fittings and premature deterioration of the injectors. Prior to changing the fittings, there had been a risk of detonation due to small pieces of brass being introduced into the injector with the fuel.
4. Air was introduced into the system when the stainless steel fittings were installed; however, the bus started up and ran very well after the air was purged from the system.
5. The lift used to pick up barrels of methanol and fuel the bus, was found to be inoperable. It was determined that the trickle charger being used to charge the deep cell battery was not functioning properly. When a different battery charger was attached to the battery, the battery charged to full capacity and the lift once again operated normally.
6. A new battery charger for the lift was purchased at a cost of \$29.99. It was checked to ensure proper operation. The bus was started and it ran normally.
7. It was necessary to recharge the bus batteries every time before starting. This problem appears to be worsening.
8. A new methanol resistant fuel pump from AC Delco, part number 1#25117203, serial number 35263083-1, was installed in the Corsica. All metal in this part is stainless steel.

Fuel pump:	\$ 506.52
Labor:	<u>\$ 160.20</u>
Total:	\$ 666.72
9. A new fuel pump for the Ford Taurus FFV was also purchased.

Fuel pump:	\$1,320.00
Labor:	<u>\$ 160.00</u>
Total:	\$1,480.00

### **3. Results and Discussion**

The bus fuel leaks were stopped with the insertion of the stainless steel fittings into the fuel lines. After charging the batteries, the bus both warmed up and idled normally. However, a new charge of the batteries was necessary; therefore, the batteries are assumed to be discharging abnormally. The cause is undetermined at this writing.

The new fuel pump for the Corsica was composed of stainless steel metal parts instead of the aluminum and brass parts integral to the failed conventional pump. After installation of the new fuel pump, the Corsica ran normally for the short distances required.

The new fuel pump for the Ford FFV has not yet been received.

## **GENERAL CONCLUSION**

All three vehicles in the program: the 1988 Chevrolet Corsica, the 1993 Ford Taurus Flexible Fuel Vehicle, and the Blitz bus performed well on methanol fuel.

Initial repairs and upgrades for the Corsica were expensive and time consuming, but most were not connected with the methanol fuel being used. Most repairs were associated with the air conditioning and faulty wiring and were probably caused by student mistakes associated with the 1989 Methanol Marathon competition and the 1990 Methanol Challenge competition. A new conventional fuel pump was installed in the fuel tank in December 1997, and surprisingly lasted one year, although methanol intolerant aluminum and brass components were clearly visible. This resistance was probably due to the non-metallic hand pump used to dispense the methanol fuel. When the fuel pump finally failed and a new conventional fuel pump was installed, it lasted only about a month because a conventional gasoline-dispensing pump with meter was used to dispense the methanol fuel. Conversations with the California Energy Commission and Ford Motor Corporation revealed that a methanol-susceptible dispensing pump would quickly corrode even a methanol resistant vehicle fuel pump. The Corsica's current methanol-resistant fuel pump will utilize fuel dispensed from the hand dispensing pump initially used, or from the brand new methanol fueling station now being built.

The commercial ether starting system used for the M-100 fuel works very efficiently, conveniently, and insures a quick start whenever used. M-100 fuels show a significant advantage when compared to M-85, as no precipitation from the gasoline component of M-85 is found when M-100 is used. Average mileage obtained for the Corsica over the length of the program was 10.88 mpg

(over 32 calculations). This amounts to a 14% increase over what would be expected from the BTU values alone. Most of the repairs in the program were made to the Corsica and amounted to:

Parts:	\$3,724
Outside labor:	<u>\$ 667</u>
Total:	\$4,391

This included the methanol-resistant fuel pump.

The bus mileage of 1.3 mpg was less than mileage observed in Jacksonville in the early nineties. Clogged injectors may be responsible. Blitz bus repairs amounted to \$3,770.76, for parts and labor. A continuous battery discharge problem persists in the bus. The cause is unknown at this time.

Average mileage for the '93 Taurus Flexible Fuel Vehicle over the range of M-85 to M-15 was 15% greater than what would be calculated on the basis of BTU value alone.

The only significant repair to the '93 Taurus FFV was for the methanol-resistant fuel pump:

Parts:	\$1,320
Outside labor:	<u>160</u>
Total:	\$1,480

An important observation was made concerning the drum port covers on the drums containing methanol-gasoline mixtures used to fuel the Ford FFV. Much more corrosion was observed on the inside of these drum covers than on those from pure-methanol-storing drums. One likely cause is that some methanol is converted to formic acid, which in turn reacts with the sulfur in the gasoline to form gaseous hydrogen sulfide, which corrodes the drum covers.

The higher the concentration of gasoline, the greater the corrosion observed. This might have important implications for fuel pump lifetimes if methanol-gasoline fuels sit for an extended time period in vehicles. This also implies that M-55 through M-85 fuels should be used whenever possible, and that addition of pure gasoline should be avoided.

In general, conversion and operation of conventionally fueled vehicles to run on methanol seem to be totally feasible and results will generally be satisfactory, depending on the original condition of the vehicle. Also, M-100 fuel and the ether starting system have some significant advantages over M-85 fuel which should be carefully evaluated and studied:

1. No precipitation of gasoline components;
2. Avoidance of cost of blending operations;
3. Avoidance of potential separation if water is introduced into the fuel;
4. Avoidance of potential of H<sub>2</sub>S formation.

The diesel bus appears to run very well on methanol fuel, though after a few thousand miles, the injector orifices expand because of the lack of lubricity in methanol fuel. Experiments with lubricant additives for the methanol fuel should be conducted. The number one candidate should be biodiesel.

## **APPENDIX**

1. Road Data for the Methanol Converted 1988 Chevrolet Corsica Utilizing M-100 Fuel
2. Road Data for the 1993 Ford Taurus Flexible Fuel Vehicle Utilizing M-0 to M-85 Fuel

### **KEY**

<b>Abbreviation</b>	<b>Location/Explanation</b>
BioWest	3325 W. New Haven Avenue. Route 192. Location of fueling station
419B	419 Bridgetown Court. Satellite Beach. Home of J. Thomas
FIT	Florida Institute of Technology
Rooney's	Restaurant in Palm Bay
FSEC	Florida Solar Energy Center
SevenEleven	7-11 fuel station close to BioWest

**ROAD DATA**  
**FOR THE METHANOL-CONVERTED**  
**1988 CHEVROLET CORSICA**  
**UTILIZING M-100 FUEL**

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/0	1:03 AM	7,018.1	Out	30	5/8	14	F	BioWest	Temperature gauge out
			161.3							
JT	01/0	1:47	"	Out	45	1/2+	14	S	BioWest	Temperature gauge out
JT	01/0	2:48	7,022.8	Out	45	1/2+	14	S	FIT	Temperature gauge out
			165.9							
JT	01/0	3:05	7,027.5	Out	30	1/2+	13	F	BioWest	Temperature gauge out
			170.6							
JT	01/0	4:37	"	Out	60	1/2+	15	S	BioWest	Temperature gauge out
	01/0	5:53	7,032.1	Out	30	1/2+	13	F	FIT	Temperature gauge out
			175.2							
JT	01/0	8:22	"	Out	60	1/2+	15	S	FIT	Temperature gauge out
JT	01/0	8:50	7,044.9	Out	38	1/2-	15	F	419B	Temperature gauge out
			188.0							
JT	01/1	1:44 PM	"	Out	60	1/2-	15	S	419B	Temperature gauge out
JT	01/1	1:56	7,050.1	Out	40	1/2-	13	F	Wal-Mart	Temperature gauge out
			193.2							
JT	01/1	2:42	"	Out	60	1/2-	15	S	Wal-Mart	Temperature gauge out
JT	01/1	3:08	7,062.0	Out	30	1/4	14	F	419B	Temperature gauge out
			205.1							
JT	01/1	4:00							419B	Added 3.5 gallons MeOH
JT	01/1 8	12:13	"	Out	63	5/8	14	S	419B	Very difficult starting, pressed starter 4 times "Service Engine Soon" light on
JT	01/1	12:53	7,082.8	Out	30	1/2	13	F	419B	"Service Engine Soon" light on
			225.9							
JT	01/1 9	8:38 AM	"	Out	65	1/2-	15	S	419B	Very difficult starting, pressed starter 6 times "Service Engine Soon" light on
JT	01/1	9:08	7,095.2	Out	30	3/8	14	F	BioWest	"Service Engine Soon" light on
			238.3							
JT	01/1	10:00	"							Added 3.0 gallons MeOH
JT	01/1	10:10	"	Out	60	1/2+	14	S	BioWest	Easy start; "Service Engine Soon" light not on
JT	01/1	10:25	7,100.0	Out	35	1/2+	14	F	FIT	"Service Engine Soon" light not on
			243.1							
JT	01/1	11:38	"	Out	60	1/2+	14	S	FIT	"Service Engine Soon" light not on

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/1	11:50 AM	7,103.8 246.9	Out	38	1/2+	14	F	Rooney's	"Service Engine Soon" light not on
JT	01/1 9	12:35 PM	"	Out	55	1/2+	15	S	Rooney's	"Service Engine Soon" light not on Instant start
JT	01/1 9	1:12	7,118.2 261.3	Out	30	1/2+	14	F	IT Via BioWest	"Service Engine Soon" light not on
JT	01/1	4:00	"	Out	60	1/2+	15	S	FIT	Starter repaired at 3:00 PM
JT	01/1	4:15	7,123.1 266.2	Out	30	1/2-	14	F	BioWest	"Service Engine Soon" light not on
JT	01/1	4:55	"	Out	55	1/2-	14	S	BioWest	"Service Engine Soon" light not on
JT	01/1	5:24	7,136.7 279.8	Out	35	1/4	14	F	419B	"Service Engine Soon" light not on
JT	01/2 0	11:23 AM	"	Out	60	3/4	15	S	419B	Very difficult starting, pressed starter 2 times Added 5.25 gallons MeOH
JT	01/2 0	11:38	7,143.1 286.2	Out	45	5/8	14	F/S	1082B/ STT	
JT	01/2	12:05 PM	7,154.6 297.7	Out	40	5/8	14	F/S	Rooney's	
JT	01/2	1:20	"	Out	60	5/8	14	S	Rooney's	
JT	01/2	2:05	7,172.7 315.8	Out	35	1/2+	13	F	419B	
JT	01/2	2:44	"	Out	70	1/2+	15	S	419B	Not bad starting
JT	01/2	2:44	7,188.4 331.5	Out	35	1/2+	14	F	BioWest	
JT	01/2	3:00								Filled fuel tank ~ 8.2 gallons
JT	01/2	3:32	"	Out	60	F+	14	S	BioWest	"Service Engine Soon" light not on
JT	01/2	3:47	7,192.7 335.8	Out	40	F+	14	F	FIT	
JT	01/2	4:29	"	Out	55	F+	14	S	FIT	
JT	01/2	4:47	7,197.5 340.6	Out	35	F+	14	F	BioWest	
JT	01/2	5:03	"	Out	40	F+	14	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/2	5:37 PM	7,210.0	Out	30	F+	13	F	419B	
			353.1							
JT	01/2	8:20 AM	"	Out	70	F-	15	S	419B	Started fairly easily; no button
JT	01/2	8:50	7,222.0	Out	35	F-	13	F	FIT	
			365.1							
JT	01/2	11:25	"	Out	60	F-	14	S	FIT	
JT	01/2	11:38	7,225.8	Out	40	F-	14	F	Rooney's	
			368.9							
JT	01/2	12:33 PM	"	Out	60	F-	14	S	Rooney's	Easy start
JT	01/2	12:53	7,235.7	Out	35	F-	14	F	BioWest	
			378.8							
JT	01/2	1:17	"	Out	45	3/4+	13	S	BioWest	
JT	01/2	1:32	7,240.0	Out	38	3/4+	13	F	FIT	
			383.1							
JT	01/2	2:49	"	Out	60	3/4+	14	S	FIT	
JT	01/2	3:05	7,244.8	Out	38	3/4	13	F	BioWest	
			387.9							
JT	01/2	4:43	"	Out	60	3/4	14	S	BioWest	
JT	01/2	5:13	7,258.4	Out	35	3/4-	13	F	419B	
			401.5							
JT	01/2	8:52 AM	"	Out	60	3/4-	15	S	419B	Difficult start – rain
JT	01/2	9:20	7,270.8	Out	35	1/2+	13	F	BioWest	
			413.9							
JT	01/2	9:33	"	Out	42	1/2+	14	S	BioWest	
JT	01/2	9:45	7,275.1	Out	32	1/2+	13	F	FIT	
			418.2							
JT	01/2	10:18	"	Out	50	1/2+	14	S	FIT	
JT	01/2	10:54	7,299.0	Out	35	1/2-	13	F	Rockledge	I-95, in the rain (192)
			442.1							
JT	01/2	11:18	"	Out	45	1/2-	13	S	Rockledge	
JT	01/2	11:49	7,315.6	Out	35	1/4	13	F	419B	I-95 to Wickham
			458.7							
JT	01/2	8:37	"	Out	70	1/4	15	S	419B	Very difficult starting

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/2	9:05 AM	7,329.2	Out	35	E	14	F	BioWest	Made it! Total miles since 01/16/98 = 382.8
			472.3							12 driving days
JT	01/2	1:00 PM								Filled w/11.0 gallons MeOH => 12.8 mpg
JT	01/2	7:25	"	Out	60	F+	15	S	BioWest	
JT	01/2	7:52	7,342.8	Out	35	F+	14	F	419B	
			485.3							
JT	01/2	8:47 AM	"	Out	70	F+	15	S	"	Pressed starter button 4 times
JT	01/2	9:13	7,354.6	Out	35	F-	14	F	FIT	
			497.7							
JT	01/2	11:28	"	Out	60	F-	14	S	FIT	Started immediately
JT	01/2	11:42	7,358.6	Out	40	F-	14	F	Rooney's	
			501.7							
JT	01/2	12:40 PM	"	Out	60	F-	14	S	Rooney's	
JT	01/2	12:58	7,368.4	Out	35	F-	14	F	BioWest	
			511.5							
JT	01/2	1:10	"	Out	40	F-	14	S	BioWest	
JT	01/2	1:37	7,377.4	Out	35	F-	13	F	BioWest	Had to return to BioWest to get steno pad
			520.5							
JT	01/2	1:43	"	Out	38	3/4+	13	S	BioWest	
JT	01/2	1:55	7,381.7	Out	30	3/4	13	F	FIT	
			524.8							
JT	01/2	2:53	"	Out	60	3/4+	14	S	FIT	Started immediately
JT	01/2	3:10	7,386.5	Out	35	3/4	13	F	BioWest	
			529.6							
JT	01/2	3:28	"	Out	45	3/4-	14	S	BioWest	
JT	01/2	3:39	7,390.0	Out	35	3/4	14	F	ARL	
			533.1							
JT	01/2	4:26	"	Out	60	3/4	15	S	ARL	
JT	01/2	4:37	7,393.5	Out	40	3/4-	14	F	BioWest	
			536.6							
JT	01/2	4:50	"	Out	45	3/4-	14	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/2	5:12 PM	7,401.5 544.6	Out	30	5/8	13	F	Rooney's	
JT	01/2	5:50	"	Out	60	5/8	14	S	Rooney's	
JT	01/2	6:00	7,405.5 548.6	Out	35	5/8	13	F	FIT	
JT	01/2	8:03	"	Out	60	3/8	14	S	FIT	
JT	01/2	8:28	7,417.2 560.3	Out	35	1/2+	14	F	419B	Overhead light out
JT	01/2	8:18 AM	"	Out	70	1/2+	15	S	419B	Pressed starter button 6 times (cold: 55° F)
JT	01/2	8:48	7,429.6 572.7	Out	38	1/2-	14	F	BioWest	
JT	01/2	9:03	"	Out	42	1/2-	14	S	BioWest	
JT	01/2	No data	7434.0 577.1					F	FIT	No data
JT	01/2	9:55	"	Out	60	1/2-	15	S	FIT	
JT	01/2	10:03	7,435.7 578.8	Out	40	1/2-	14	F	ARL	
JT	01/2	10:08	"	Out	45	1/2-	14	S	ARL	
JT	01/2	10:18	7,439.3 582.4	Out	38	1/2-	14	F	BioWest	
JT	01/2	11:38	"	Out	60	1/2-	14	S	BioWest	
JT	01/2	11:56	7,447.3 590.4	Out	30	1/4	14	F	Rooney's	
JT	01/2	12:42 PM	"	Out	60	1/4	14	S	Rooney's	
JT	01/2	1:03	7,457.2 600.3	Out	38	Red Mark	14	F	BioWest	
JT	01/2	1:40	"							Filled w/11 gallons MeOH => 11.64 mpg
JT	01/2	2:00	"	Out	60	F+	14	S	BioWest	
JT	01/2	2:15	7,461.6 604.7	Out	35	F+	13	F	FIT	
JT	01/2	3:20	"	Out	60	F+	14	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/2	3:40 PM	7,466.6 609.7	Out	38	F+	14	F	BioWest	
JT	01/2	5:08	"	Out	60	F+	14	S	BioWest	
JT	01/2	5:45	7,480.2 623.3	Out	35	F-	14	F	419B	
JT	01/2	8:09 AM	" 7,492.6 635.7	Out	70	F-	15	S F	419B BioWest	Very difficult start (46° F), >10 attempts
JT	01/2	9:08	"	Out	60	F-	14	S	BioWest	
JT	01/2	9:20	7,496.8 639.9	Out	40	3/4+	13	F	FIT	
JT	01/2	10:02	"	Out	60	3/4+	14	S	FIT	
JT	01/2	10:20	7,502.0 645.1	Out	35	3/4+	14	F	BioWest	Very difficult shifting in low gears
JT	01/2	11:55	"	Out	60	3/4+	14	S	BioWest	
JT	01/2	12:15 PM	7,510.0 653.1	Out	35	3/4+	13	F	Rooney's	Very difficult shifting in low gears
JT	01/2	1:03	"	Out	50	3/4+	14	S	Rooney's	
JT	01/2	1:22	7,519.8 662.9	Out	35	3/4-	13	F	BioWest	
JT	01/2	1:53	"	Out	45	3/4-	14	S	BioWest	
JT	01/2	2:12	7,525.8 668.9	Out	35	3/4-	13	F	FIT	
JT	01/2	2:50	"	Out	50	5/8	13	S	FIT	Tough shifting
JT	01/2	3:08	7,530.3 673.4	Out	35	5/8	13	F	BioWest	
JT	01/2	5:26	"	Out	60	5/8	14	S	BioWest	Easy start
JT	01/2	5:42	7,534.4 677.5	Out	45	1/2+	13	F	FIT	All miles air conditioned
JT	01/2	8:00	"	Out	60	1/2+	14	S	FIT	Smelled of burning
JT	01/2	8:25	7,546.3 689.4	Out	35	1/2+	14	F	419B	
JT	02/0	10:35 AM	"	Out	60	1/2+	15	S	419B	Easy start; clutch no problem

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	02/0	11:00 AM	7,558.5	Out	35	1/2-	14	F	FIT	
			701.6							
JT	02/0	11:32	"	Out	50	1/2-	14	S	FIT	Easy start, clutch no problem
JT	02/0	11:42	7,562.4	Out	35	1/2-	13	F	Rooney's	Easy start, clutch no problem
			705.5							
JT	02/0	12:28 PM	"	Out	55	1/2-	14	S	Rooney's	Easy start, clutch no problem
JT	02/0	12:47	7,572.3	Out	35	3/8	13	F	BioWest	
			715.4							
JT	02/0	1:00								Filled w/10.2 gallons MeOH => 11.27 mpg
JT	02/0	2:00	"	Out	60	F+	14	S	BioWest	
JT	02/0	2:17	7,576.5	Out	35	F+	13	F	FIT	
			719.6							
JT	02/0	3:29	"	Out	60	F+	14	S	FIT	Very tough shifting
JT	02/0	3:50	7,581.4	Out	35	F+	13	F	BioWest	Shifting not too bad
			724.5							
JT	02/0	2:28	"	Out	60	F+	14	S	BioWest	
JT	02/0	2:48	7,586.1	Out	40	F+	14	F	FIT	Car shipped out for repairs
			729.2							
JT	03/0	10:25 AM	7,602.2	Out	70	3/4	15	S	FIT	Starting was a little difficult; the clock is not right
			745.3							
JT	03/0	10:42	7,606.8	Out	40	3/4-	13	F	BioWest	
			745.9							
JT	03/0	11:35	"	Out	60	3/4-	13	S	BioWest	Instant start
JT	03/0	11:49	7,611.1	Out	38	1/2+	13	F	FIT	
			754.2							
JT	03/0	1:05 PM	"	Out	60	1/2+	14	S	FIT	
JT	03/0	1:23	7,615.9	Out	42	1/2+	13	F	BioWest	Filled w/7.0 gallons MeOH
			759.0							
JT	03/0	2:28	"	Out	55	F+	13	S	BioWest	
JT	03/0	2:44	7,620.2	Out	55	F+	13	F	FIT	
			763.3							
JT	03/0	4:13	"	Out	60	F+	14	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/0	4:31 PM	7,625.0	Out	35	F+	13	F	BioWest	
			768.1							Filled w/7 gallons MeOH => 5.54 mpg
JT	03/0	5:13	7625.0	Out	60	F+	14	S	BioWest	
JT	03/0	5:30	7,629.5	Out	35	F+	13	F	FIT	
			772.6							
JT	03/0		"	Out		F		S	FIT	Very hard starting – too much ether
JT	03/0	10:28 AM	7,634.2	Out	40	F-	13	F	BioWest	
			777.3							
JT	03/0	11:18	"	Out	60	F-	14	S	BioWest	Instant start
JT	03/0	11:43	7,647.8	Out	35	F-	13	F	419B	By Wickham Road
			790.9							
JT	03/0	12:50 PM	"	Out	60	F-	14	S	419B	Instant start
JT	03/0	1:33	7,664.4	Out	35	3/4	13	F	BioWest	Via Riverside and FIT
			807.5	Out						
JT	03/0	1:55	"	Out	45	3/4	13	S	BioWest	
JT	03/0		7,668.7	Out		3/4+		F	FIT	
			811.8							
JT	03/0	3:10	"	Out	50	3/4+	13	S	FIT	
JT	03/0	3:25	7,673.6	Out	40	3/4-	13	F	BioWest	
			816.7							
JT	03/0	3:33	"	Out	40	3/4-	13	S	BioWest	
JT	03/0	4:08	7,687.2	Out	35	1/2+	13	F	419B	
			830.3							
JT	03/0	6:05	"	Out	60	1/2+	15	S	419B	
JT	03/0	6:29	7,699.3	Out	39	1/2	14	F	FIT	
			842.4							
JT	03/0	8:14	"	Out	60	1/2+	14	S	FIT	Instant start
JT	03/0	8:40	7,711.3	Out	35	1/2	14	F	419B	
			854.4							
JT	03/0	8:19 AM	"	Out	70	1/2-	16	S	419B	Tough starting; pressed starter 3 times
JT	03/0	8:53	7,723.7	Out	35	1/4	14	F	BioWest	
			866.8							
JT	03/0	9:00	"	Out	40	1/4	14	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/0	9:12 AM	7,728.0	Out	40	1/4	14	F	FIT	
			871.1							
JT	03/0	10:15	"	Out	60	1/4	15	S	FIT	
JT	03/0	10:30	7,732.6	Out	35	Red Mark	13	F	BioWest	Performed well at low fuel level
			875.7							Filled w/11.6 gallons MeOH => 9.28 mpg
JT	03/0	1:23 PM	"	Out	60	F+	14	S	BioWest	
JT	03/0	1:37	7,737.3	Out	40	F+	13	F	FIT	
			880.4							
JT	03/0	2:43	"	Out	60	F+	14	S	FIT	
JT	03/0	2:58	7,742.1	Out	40	F+	13	F	BioWest	
			885.2							
JT	3/04	3:53	"	Out	60	F+	14	S	BioWest	
JT	03/0	4:08	7,746.4	Out	35	F+	13	F	FIT	
			889.5							
JT	03/0	4:20	"	Out	45	F+	13	S	FIT	
JT	03/0	4:38	7,751.2	Out	35	F	13	F	BioWest	
			894.3							
JT	03/0	4:51	"	Out	40	F-	14	S	BioWest	
JT	03/0	5:13	7,759.3	Out	35	F-	13	F	Rooney's	
			902.4							
JT	03/0	5:48	"	Out	42	F-	13	S	Rooney's	
JT	03/0	6:16	7,773.7	Out	35	F-	13	F	419B	
			916.8							
JT	03/0	12:33	"	Out	70	F-	15	S	419B	Fairly easy starting
JT	03/0	1:13	7,790.2	Out	30	3/4	13	F	BioWest	Via FIT and South Patrick Drive
			933.3							
JT	03/0	1:25	"	Out	40	3/4	13	S	BioWest	
JT	03/0	1:40	7,794.7	Out	40	3/4-	13	F	FIT	
			937.8							
JT	03/0	3:43	"	Out	65	3/4-	14	S	FIT	
JT	03/0	4:03	7,799.4	Out	35	3/4-	13	F	BioWest	At idle: 1000 RPMs
			942.5							
JT	03/0	4:20	"	Out	45	3/4-	13	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/0	4:40 PM	7,807.5	Out	40	1/2+	13	F	Rooney's	
			950.6							
JT	03/0	5:17	"	Out	60	1/2+	14	S	Rooney's	
JT	03/0	5:28	7,811.5	Out	40	1/2+	13	F	FIT	
			954.6							
JT	03/0	8:05	"	Out	60	1/2+	14	S	FIT	
JT	03/0	8:16	7,815.4	Out	45	1/2+	13	F	Rooney's	
			958.5							
JT	03/0	8:52	"	Out	60	1/2+	14	S	Rooney's	
JT	03/0	9:20	7,829.1	Out	35	1/2	13	F	419B	
			972.2							
JT	03/1	3:33	7,937.0	165	60	F+	14	S	BioWest	New temperature gauge installed
			80.1							Filled w/11.05 gallons MeOH
JT	03/1	3:51	7,944.7	190	40	F+	13	F	FIT	
			87.8							
JT	03/1	4:18	"	120	55	F+	13	S	FIT	
JT	03/1	4:33	7,946.3	198	40	F+	13	F	BioWest	
			89.4							
JT	03/1	9:05	"	100	60	F+	13	S	BioWest	
JT	03/1	9:29	7,959.8	190	35	F-	12	F	419B	Via Wickham Road
			102.9							
JT	03/1	7:34 AM	"	10	60	F-	15	S	419B	
JT	03/1	8:09	7,972.2	195	35	F-	13	F	BioWest	Via South Patrick Drive
			115.3							
JT	03/1	8:21	"	190	45	3/4+	13	S	BioWest	
JT	03/1	8:35	7,976.9	190	35	3/4	13	F	FIT	
			120.0							
JT	03/1	10:40	"	125	60	3/4+	14	S	FIT	
JT	03/1	10:53	7,981.6	192	45	3/4	13	F	BioWest	
			124.7							
JT	03/1	11:35	"	160	60	3/4	14	S	FIT	
JT	03/1	11:54	7,989.6	203	35	3/4-	13	F	Rooney's	
			132.7							

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/1	1:15 PM	"	150	60	3/4	14	S	Rooney's	
JT	03/1	1:35	7,999.5	195	35	3/4-	13	F	BioWest	
			142.6							
JT	03/1	2:03	"	172	50	3/4-	14	S	BioWest	
JT	03/1	2:17	8,003.8	200	35	1/2+	13	F	FIT	
			146.9							
JT	03/1	3:13	"	165	60	1/2+	13	S	FIT	
JT	03/1	3:33	8,008.8	200	35	1/2+	13	F	BioWest	
			151.9							
JT	03/1	4:24	"	160	60	1/2+	14	S	BioWest	
JT	03/1	4:28	8,009.2	185	50	1/2+	13	F	Rom Bakery	
			152.3							
JT	03/1	4:58	"	160	60	1/2+	13	S	Rom Bakery	
JT	03/1	5:10	8,013.1	190	40	1/2	13	F	FIT	
			156.2							
JT	03/1	7:42	"	110	60	1/2+	14	S	FIT	
JT	03/1	8:07	8,025.7	195	35	1/2	13	F	419B	
			168.8							
JT	03/2	8:18 AM	"	100	70	1/2-	15	S	419B	Turned key, hit button, instant start
JT	03/2	8:47	8,032.2	193	30	1/4	13	F	BioWest	
			175.3							
JT	03/2	8:53	"	193	40	1/4+	14	S	BioWest	
JT	03/2	9:08	8,042.1	198	38	1/4	13	F	FIT	
			185.2							
JT	03/2	10:03	"	160	60	1/4	14	S	FIT	
JT	03/2	10:16	8,047.5	190	40	Red Mark	13	F	BioWest	Filled w/11.6 gallons MeOH => 11.48 mpg
			190.6							
JT	03/2	3:08 PM	"	100	60	F+	15	S	BioWest	
JT	3/23	3:20	8,051.3	190	45	F+	14	F	FIT	
			194.4							
JT	3/23	4:28	"	150	60	F+	14	S	FIT	
" means ditto for <u>both</u> mileage 1 and mileage 2										

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	3/23	4:45 PM	8,056.6	195	35	F+	13	F	BioWest	
			199.7							
JT	3/23	5:08	"	175	60	F+	13	S	BioWest	
JT	3/23	5:40	8,070.2	198	35	F-	13	F	419B	
			213.3							
JT	3/24	7:29 AM	"	100	60	F-	14	S	419B	Instant start
JT	3/24	8:25	8,082.6	203	35	F-	13	F	BioWest	
			225.7							
JT	3/24	9:38	"	150	60	3/4+	14	S	BioWest	
JT	3/24	9:55	8,087.0	203	40	3/4+	13	F	FIT	
			230.1							
JT	3/24	12:33 PM	8,091.5	170	60	3/4+	13	S	Rooney's	
			234.6							
JT	3/24	12:49	8,101.5	195	35	3/4	13	F	BioWest	
			244.6							
JT	3/24	1:30	"	170	50	3/4	13	S	BioWest	
JT	3/24	1:44	8,105.7	203	35	3/4-	13	F	FIT	
			248.8							
JT	3/24	2:40	"	165	60	3/4-	14	S	FIT	
JT	3/24	2:56	8,110.4	203	35	1/2+	13	F	BioWest	
			253.5							
JT	3/24	4:35	"	150	60	1/2+	14	S	BioWest	
JT	3/24	4:58	8,118.7	203	35	1/2+	13	F	Rooney's	
			261.8							
JT	3/24	5:27	"	180	50	1/2+	13	S	FIT	
JT	3/24	5:40	8,122.7	195	35	1/2+	13	F	FIT	
			265.8							
JT	3/24	7:57	"	150	60	1/2+	14	S	FIT	
JT	3/24	8:21 AM	8,134.3	192	40	1/2	13	F	419B	
			277.4							
	3/25	8:04	"	100	60	1/2+	15	S	419B	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
	3/25	8:40 AM	8,146.7	205	35	1/2-	13	F	BioWest	Instant start, key, button, ignition order
			289.8							
JT	3/25	9:15	8,146.7	170	50	1/2-	14	S	BioWest	
			289.8							
JT	3/25	9:29	8,151.0	200	40	1/4	13	F	FIT	
			294.1							
JT	3/25	10:10	"	170	55	1/4	13	S	FIT	
JT	3/25	10:23	8,155.8	199	35	RedMar	73	F	BioWest	Fill up w/11.0 gallons => 9.85 mpg
			298.9							
JT	3/25	2:07 PM	"	110	60	F+	14	S	BioWest	
JT	3/25	2:20	8,160.7	192	55	F+	13	F	FIT	
			303.8							
JT	3/25	3:25	"	150	60	F+	14	S	FIT	
JT	3/25	3:39	8,165.1	200	35	F+	13	F	BioWest	
			308.2							
JT	3/25	4:50	"	160	60	F+	14	S	BioWest	
JT	3/25	5:20	8,178.7	195	35	F	13	F	419B	Via Wickham Road
			321.8							
JT	3/27	8:21 AM	"	100	70	F-	15	S	419B	Instant start with ET <sub>2</sub> O
JT	3/27	8:51	8,191.2	193	35	F-	13	F	BioWest	
			334.3							
JT	3/27	11:31	"	120	60	3/4+	13	S	FIT	
JT	3/27	11:43	8,199.4	195	35	3/4+	13	F	Rooney's	
			342.5							
JT	3/27	12:45 PM	"	160	60	3/4+	13	S	Rooney's	
JT	3/27	1:06	8,209.3	195	35	3/4	13	F	BioWest	
			352.4							
JT	5/20	11:30 AM	8,236.7	150	60	3/4	14	S	BioWest	Last of old LPMeOH, NO AC
			379.8							
JT	5/20	11:58	8,250.3	202	30	3/4	14	F	419B	Smooth ride
			393.4							
JT	5/20	12:53 PM	"	170	60	3/4	14	S	419B	Easy start

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	5/20	1:24 PM	8,262.7	222	20	3/4-	13	F	BioWest	High temp?
			405.8							
JT	5/20	1:33	"	215	30	3/4-	14	S	BioWest	Easy start
JT	5/20	1:47	8,267.4	210	30	1/2+	13	F	FIT	
			410.5							
JT	5/20	2:28	"	190	45	1/2+	14	S	FIT	
			8,272.1	215	35	1/2+	13	F	BioWest	Smooth ride
JT	5/20	2:44	415.2							
JT	5/20	3:19	"	195	45	1/2+	14	S	BioWest	
JT	5/20	3:34	8,276.5	203	30	1/2+	13	F	FIT	
			419.6							
JT	5/20	4:02	"	190	40	1/2+	14	S	FIT	Smooth ride
JT	5/20	4:17	8,281.1	230	30	1/2	13	F	BioWest	
			424.2							
JT	5/20	4:21	"	220	30	1/2	13	S	BioWest	
JT	5/20	4:36	8,285.2	220	30	1/2	13	F	FIT	Smooth ride
			428.3							
JT	5/21	9:58 AM	"	100	70	1/2+	15	S	FIT	Easy start
JT	5/21	10:14	8,290.4	200	35	1/2-	14	F	BioWest	
			433.5							
JT	5/21	10:35	"	185	50	1/2-	14	S	BioWest	
JT	5/21	10:50	8,295.3	208	35	1/2-	13	F	FIT	
			438.4							
JT	5/21	11:35	"	180	60	1/2-	14	S	FIT	
JT	5/21	12:03 PM	8,307.5	205	35	1/2-	14	F	419B	
			450.6						419B	
JT	5/21	1:00	"	180	50	1/2-	14	S	419B	Easy start
JT	5/21	1:28 PM	8,319.5	210	30	1/4	13	F	FIT	
			462.6							
JT	5/21	3:05	8,328.5	205	35	F+	14	S	FIT	Filled w/new MeOH
			471.6							
JT	5/21	3:15	8,329.2	220	35	F+	13	S	FIT	
			472.3							

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	5/21	3:43 PM	8,337.8	220	35	F+	13	S	BTR	
JT			480.9							
JT	5/21	4:05	8,344.4	222	35	F-	13	F	FIT	
			487.5							
JT	5/22	10:08 AM	"	100	70	F-	16	S	FIT	
JT	5/22	10:25	8,350.1	200	40	F-	14	F	BioWest	
			493.2							
JT	5/22	11:01	"	170	70	F-	14	S	BioWest	
JT	5/22	11:10	8,352.0	205	38	F-	14	F	1st Union	192
			495.1							
JT	5/22	11:20 AM	"	203	42	F-	14	S	1st Union	192
JT	5/22	11:42	8,358.8	220	38	3/4+	13	F	Rooney's	
			501.9							
JT	5/22	12:37 PM	"	190	40	3/4+	13	S	Rooney's	
JT	5/22	12:58	8,368.6	210	38	3/4	14	F	BioWest	
			511.7							
JT	5/22	1:18	"	200	42	3/4	14	S	BioWest	
JT	5/22	1:32	8,373.0	210	37	3/4	14	F	FIT	
			516.1							
JT	5/22	2:05	"	195	45	3/4	14	S	FIT	Filled up to overflow
JT	5/22	4:25	8,388.0	200	35	F+	14	S	BioWest	
			531.1							
JT	5/22	4:40	8,392.1	210	35	F+	13	F	FIT	
			535.2							
JT	6/1	11:30 AM	"	100	70	F+	14	S	FIT	Easy start; no ether; hot day
JT	6/1	11:56 AM	8,404.0	208	35	F+	14	F	419B	
			547.1							
JT	6/1	1:03 PM	"	170	60	F-	14	S	419B	
JT	6/1	1:28	8,416.0	211	35	F-	13	F	FIT	
			559.1							
JT	6/1	4:13	"	150	70	F-	14	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/1	4:40 PM	8,427.9	215	35	F-	14	F	419B	
			571.0							
JT	6/1	6:50	"	150	60	F-	14	S	419B	Easy start
JT	6/1	7:17	8,439.9	211	30	3/4	13	F	FIT	
			583.0							
JT	6/2	10:07 AM	"	100	70	3/4+	14	S	FIT	Very easy start hot day
JT	6/2	10:23	8,444.7	205	35	3/4-	14	F	BioWest	
			587.8							
JT	6/2	11:20	"	165	60	3/4-	14	S	BioWest	
JT	6/2	11:47	8,458.3	210	30	1/2+	13	F	419B	
			601.4							
JT	6/2	12:58 PM	"	170	70	1/2+	14	S	419B	
JT	6/2	1:28	8,470.7	215	30	1/2+	13	F	BioWest	
			613.8							
JT	6/2	1:38	"	220	38	1/2+	14	S	BioWest	
JT	6/3	2:40	8,479.8	210	35	1/2	12	F	BioWest	Slight hesitation in low gear
			622.9							
JT	6/4	3:05	8,490.2	140	60	F+	13	S	FIT	Filled w/MeOH ~ 11+ gallons => 10.50 mpg; to I92 to I95 to Malabar to Babcock to Palm
			633.3							
JT	6/4	3:50	8,515.3	213	35	F+	12	F	BioWest	to I95 to I92 to BioWest
	6/4		658.4							Runs fine after filling
JT	6/4	4:36	"	195	40	F+	13	S	BioWest	
JT	6/4	5:08	8,527.8	210	30	F-	12	F	419B	
			670.9							
JT	6/5	9:55 AM	8,539.8	180	60	F-	13	S	FIT	
			682.9							
JT	6/5	10:14	8,546.7	208	35	3/4	12	F	BTR	
			689.8							
JT	6/5	10:23	"	195	40	3/4	12	S	BTR	
JT	6/5	11:47	"	172	50	3/4-	13	S	FIT	
JT	6/5	10:40	8,553.5	210	35	3/4-	12	F	FIT	
			696.6							

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/5	12:00 PM	8,557.2	215	35	3/4-	13	F	Rooney's	
			700.3							
JT	6/5	12:55	"	190	42	3/4-	12	S	Rooney's	
JT	6/5	1:13	8,567.1	210	35	1/2+	13	F	BioWest	
			710.2							
JT	6/5	1:25	"	200	38	1/2+	12	S	BioWest	
JT	6/5	1:42	8,571.6	215	38	1/2+	12	F	FIT	
			714.7							
JT	6/8	2:38	"	140	60	1/2+	13	S	FIT	
JT	6/8	2:53	8,576.2	202	35	1/2+	12	F	BioWest	
			719.3							
JT	6/8	3:58	"	170	60	1/2+	13	S	BioWest	
JT	6/8	4:13	8,580.8	202	35	1/2	12	F	FIT	
			723.9							
JT	6/10	9:14 AM	"	100	70	1/2	13	S	FIT	
JT	6/10	9:29	8,585.5	200	40	1/2-	13	F	BioWest	Engine? Fuel flow skips? low on fuel?
			728.6							
JT	6/10	9:48	"	185	45	1/2-	13	S	BioWest	
JT	6/10	10:00	8,589.8	202	35	1/4	13	F	FIT	Less of above
			732.9							
JT	6/10	10:36	"	180	50	1/2-	13	S	FIT	
JT	6/10	10:53	8,594.6	201	48	red line	12	F	BioWest	Filled w/11.4 gallons MeOh => 9.16 mpg
			737.7							All miles air conditioned
JT	6/10	2:35 PM	"	130	70	F+	14	S	BioWest	
JT	6/10	2:50	8,598.5	202	35	F+	12	F	FIT	Smooth ride
			741.6							
JT	6/10	3:52	"	172	55	F+	13	S	FIT	
JT	6/10	4:09	8,603.0	215	35	F+	13	F	BioWest	
			746.1							
JT	6/10	4:33	"	195	40	F+	13	S	BioWest	
JT	6/10	4:54	8,611.8	208	35	F+	12	F	Rooney's	
			754.9							

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/12	10:37 AM	8,618.2	100	70	F+	14	S	FIT	To Babcock, to Malabar, to I-95, to Fiske, to I-95
JT	6/12	11:45	8,673.1	215	35	3/4-	13	F	Rooney's	
			816.2							
JT	6/12	12:30 PM	"	190	45	3/4-	13	S	Rooney's	
JT	6/12	12:50	8,682.0	210	35	1/2+	13	F	BioWest	
			825.1							
JT	6/12	1:03	"	200	38	1/2+	13	S	BioWest	
JT	6/12	1:22	8,687.3	213	35	1/2+	12	F	FIT	
			830.4							
JT	6/12	2:03	"	190	42	1/2+	13	S	FIT	To Babcock, to Malabar, to I-95, to Fiske, to Wickham
		3:10	8,731.3			RedMark		F	Dans Welding	Out of fuel at Dan's Welding
			874.4							Filled w/5.0 gallons MeOH and drove 1.4 miles to BioWest.
JT	6/12	4:55	8,732.7	170	60	F+	13	S	BioWest	Total 11.89 gals => 11.92 mpg!
			875.8							
JT	6/12	5:14	8,737.4	208	35	F+	12	F	FIT	
			880.5							
JT	6/16	8:14 AM	"	110	70	F+	14	S	FIT	
JT	6/16	8:27	8,742.0	202	38	F+	13	F	BioWest	
			885.1							
JT	6/16	9:08	"	170	60	F+	14	S	BioWest	
JT	6/16	9:22	8,747.0	208	38	F+	13	F	FIT	
			890.1							
JT	6/16	9:47	"	190	45	F+	13	S	FIT	
JT	6/16	10:00	8,751.9	205	38	F+	13	F	BioWest	
			895.0							
JT	6/16	10:50	"	180	45	F+	13	S	BioWest	
JT	6/16	11:03	8,756.1	210	38	F+	13	F	FIT	
			899.2							
JT	6/16	11:25	"	200	40	F+	13	S	FIT	Via 192 & Country Club Road

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/16	11:39 AM	8,760.9	210	38	F-	13	F	BioWest	
			904.0							
JT	6/16	2:02 PM	"	150	60	F+	13	S	BioWest	
JT	6/16	2:33	8,771.1	211	33	F-	13	F	BTR	
			914.2							
JT	6/16	2:40	"	200	38	F-	12	S	BTR	
JT	6/16	3:05	8,777.3	218	35	F	12	F	FIT	
			920.4							
JT	6/16	3:10	"	210	38	F-	12	S	FIT	
JT	6/16	2:24	8,781.9	218	38	3/4+	12	F	BioWest	
			925.0							
JT	6/17	10:33 AM	8,782.1	110	70	3/4+	14	S	BioWest	
			925.2							
JT	6/17	10:45	8,786.3	200	40	3/4-	13	F	FIT	
			929.4							
JT	6/17	11:43	"	170	60	3/4	13	S	FIT	
JT	6/17	11:55	8,790.4	215	38	3/4-	12	F	Rooney's	
			933.5							
JT	6/17	12:32 PM	"	190	42	3/4-	13	S	Rooney's	
JT	6/17	12:53	8,800.2	215	38	1/2+	13	F	FIT	
			943.3							
JT	6/17	1:03	"	210	38	1/2+	13	S	BioWest	
JT	6/17	1:20	8,804.8	215	35	1/2+	12	F	FIT	
			947.9							
JT	6/17	1:38	"	202	39	1/2+	13	S	FIT	
JT	6/17	1:53	8,810.4	215	38	1/2+	12	F	BioWest	
			953.5							
JT	6/17	2:15	"	202	39	1/2+	13	S	BioWest	
JT	6/17	2:28	8,814.7	210	38	1/2+	13	F	FIT	
			957.8							
JT	6/17	3:51	"	170	60	1/2+	13	S	FIT	Starting to need filling

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/17	4:08 PM	8,819.8	215	35	1/2-	12	F	BioWest	
			962.9							
JT	6/18	9:07 AM	"	110	73	1/2-	14	S	BioWest	None bucking
JT	6/18	9:20	8,823.9	202	40	1/2-	13	F	FIT	
			967.0							
JT	6/18	10:02	"	172	65	1/2-	13	S	FIT	
JT	6/18	10:18	8,828.8		38	1/4		F	BioWest	Stalled 4 times. Filled w/10.68 gallons => 9.0
			971.9							
JT	6/19	8:43	"	110	75	F+	15	S	BioWest	
JT	6/19	8:55	8,833.2	205	40	F+	13	F	FIT	
			976.3							
JT	6/19	9:11	"	190	45	F+	14	S	FIT	
JT	6/19	9:24	8,839.2	208	38	F+	13	F	BTR lab	
			982.3							
JT	6/19	9:37	"	198	40	F+	13	S	BTR lab	
JT	6/19	9:54	8,845.6	215	38	F+	12	F	FIT	
			988.7							
JT	6/19	11:25	"	170	60	F+	13	S	FIT	
JT	6/19	11:36	8,849.6	215	38	F+	13	F	Rooney's	
			992.7							
JT	6/19	12:19 PM	"	190	42	F+	13	S	Rooney's	
JT	6/19	12:35	8,855.5	215	38	F+	12	F	BTR	
			998.6							
JT	6/19	12:38	"	212	38	F+	12	S	BTR	
JT	6/19	12:53	8,861.7	218	38	F-	12	F	FIT	
			4.8							
JT	6/19	1:50	"	190	42	F-	12	S	FIT	
JT	6/19	2:04	8,866.5	218	38	F-	12	F	BioWest	
			9.6							
JT	6/19	3:20	"	180	42	F-	13	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/19	3:33 PM	8,870.7	210	30	F-	12	F	FIT	
			13.8							
JT	6/19	3:48	"	200	40	F-	12	S	FIT	
JT	6/19	4:05	8,875.6	215	35	3/4+	12	F	BioWest	
			18.7							
JT	6/22	8:35 AM	"	120	70	3/4+	15	S	BioWest	
JT	6/22	8:47	8,879.9	200	40	3/4	13	F	FIT	Needed ether to start
			23.0							
JT	6/22	11:10	"	140	70	3/4	14	S	FIT	
JT	6/22	11:34	8,884.4	203	38	3/4	12	F	BioWest	
			27.5							
JT	6/22	1:48 PM	"	150	60	3/4	13	S	BioWest	
JT	6/22	2:02	8,888.6	210	38	3/4	12	F	FIT	
			31.7							
JT	6/22	2:38	"	188	50	3/4	13	S	FIT	
JT	6/22	2:53	8,893.1	215	30	3/4-	12	F	BioWest	
			36.2							
JT	6/23	9:12 AM	"	110	70	3/4-	15	S	BioWest	
JT	6/23	9:38	8,903.7	202	38	1/2+	13	F	BTR	
			46.8							
JT	6/23	9:57	"	193	40	1/2+	13	S	BTR	
JT	6/23	10:07	8,907.6	210	38	1/2+	12	F	Barnett	
			50.7							
JT	6/23	10:13	"	205	38	1/2+	13	S	Barnett	
JT	6/23	10:21	8,910.0	210	38	1/2	13	F	FIT	
			53.1							
JT	6/23	10:17	"	180	68	1/2+	13	S	FIT	
JT	6/23	11:30	8,914.2	215	38	1/2	12	F	BioWest	Filled w/9.58 gallons => 8.91 mpg
			57.3							
JT	6/23	3:00 PM	"	150	60	F+	13	S	BioWest	
JT	6/23	3:12	8,918.3	208	38	F+	12	F	Rialto	
			61.4							
JT	6/23	3:37	"	193	42	F+	13	S	Rialto	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/23	3:52 PM	8,922.6	218	38	F+	12	F	BioWest	
			65.7							
JT	6/25	9:10 AM	"	100	70	F+	15	S	BioWest	
JT	6/25	9:20	8,926.9	195	45	F+	13	F	FIT	
			70.0							
JT	6/25	10:58	"	150	70	F+	14	S	FIT	
JT	6/25	11:08	8,930.1	200	40	F+	13	F	Travelmax	
			73.2							
JT	6/25	11:13	"	202	40	F+	13	S	Travelmax	
JT	6/25	11:21	8,932.2	203	38	F+	12	F	BioWest	
			75.3							
JT	6/25	1:34 PM	"	150	60	F+	13	S	BioWest	
JT	6/25	1:46	8,936.5	204	40	F+	13	F	FIT	
			79.6							
JT	6/25	3:00	"	165	60	F+	13	S	FIT	
JT	6/25	3:14	8,941.0	216	35	F+	12	F	BioWest	
			84.1							
JT	6/26	9:08 AM	"	100	70	F	14	S	BioWest	
JT	6/26	9:23	8,945.6	40		F-		F	FIT	
			88.7							
JT	6/26	10:23	"	155	70	F-	14	S	FIT	
JT	6/26	10:36	8,951.8	207	38	F-	13	F	BTR	
			94.9							
JT	6/26	10:53	"	198	40	F-	13	S	BTR	
JT	6/26	11:03	8,955.7	210	38	F-	12	F	Barnett	
			98.8							
JT	6/26	11:09	"	203	38	F-	13	S	Barnett	
JT	6/26	11:17	8,958.1	213	38	F-	13	F	FIT	
			101.2							
JT	6/26	11:36	"	201	40	F-	13	S	FIT	
JT	6/26	11:48	8,962.0	218	38	3/4+	12	F	Rooney's	
			105.1							
JT	6/26		"					S	Rooney's	

" means ditto for both mileage 1 and mileage 2

Operator	1998 Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	6/26	1:19 PM	8,971.9	210	38	3/4	13	F	BioWest	
			115.0							
JT	6/26	1:32	"	201	38	3/4	13	S	BioWest	
JT	6/26	1:47	8,973.7	210	38	3/4	12	F	Travelmax	
			118.6							
JT	6/26	1:52	"	208	38	3/4-	12	S	Travelmax	
JT	6/26	2:03	8,979.1	203	38	3/4-	12	F	FIT	
			122.2							
JT	6/26	2:38	"	180	42	3/4-	13	S	FIT	
JT	6/26	2:51	8,982.6	209	38	1/2+	12	F	Travelmax	
			125.7							
JT	6/26	3:04	"	199	39	1/2+	12	S	Travelmax	
JT	6/26	3:13	8,984.8	212	38	1/2+	12	F	BioWest	
			127.9							
JT	6/29	9:00 AM	"	110	70	1/2+	14	S	BioWest	
JT	6/29	9:15	8,989.5	208	38	1/2+	13	F	FIT	
			132.6							
JT	6/29	10:23	"	170	50	1/2+	14	S	FIT	
JT	6/29	10:35	8,993.2	210	38	1/2+	13	F	Travelmax	
			136.3							
JT	6/29	10:45	"	203	39	1/2+	13	S	Travelmax	
JT	6/29	10:53	8,995.3	208	38	1/2+	12	F	BioWest	
			138.4							
JT	6/29	1:55 PM	"	150	70	1/2+	14	S	BioWest	
JT	6/29	2:10	8,999.6	208	38	1/2	12	F	FIT	
			142.7							
JT	6/29	2:53	"	170	50	1/2	13	S	FIT	
JT	6/29	3:14	9,004.2	218	35	1/2-	12	F	BioWest	Filled w/9.97 gallon => 9.04 mpg
			147.3							
JT	6/30	9:13 AM	"	110	73	F+	15	S	BioWest	
JT	6/30	9:26	9,008.3		40	F+		F	FIT	
JT	6/30	10:30	151.4	170	60	F+	14	S	FIT	
JT	6/30	10:45	9,008.5	210	38	F+	12	F	FIT	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	08/1	12:38 PM	9,295.7	180	42	3/4+	13	S	Rooney's	
			438.8							
JT	08/1	12:56	9,305.6	208	38	3/4	13	S	BioWest	
			448.7							
JT	08/1	1:15	"	199	40	3/4	13	S	BioWest	
JT	08/1	1:32	9,310.3	210	38	3/4	12	F	FIT	
			453.4							
JT	08/1	2:09	"	195	40	3/4-	13	S	FIT	
JT	08/1	2:21	9,313.0	212	38	3/4-	13	F	First Union	
			456.1							
JT	08/1	2:50	9,319.9	208	38	1/2+	13	S	First Union	Palm Bay
			463.0							
JT	08/1	3:10	9,329.1	208	38	1/2+	13	F	BioWest	Filled w/8.4 gallons MeOH
			472.2							*Used the pump, as a faulty gauge is suspected
JT	08/2	9:33 AM	"	150	60	F+	13	S	BioWest	
JT	08/2	9:48	9,333.7	200	38	F+	12	F	FIT	
			476.8							
JT	08/2	10:18	9,338.6	205	38	F+	13	F	BioWest	
			481.7							
JT	08/2	11:43	9,338.6	180	45	F+	14	S	BioWest	
			481.7							
JT	08/2	12:10 PM	9,349.0	203	38	F+	12	F	Rooney's	
			492.1							
JT	08/2	12:48	"	178	43	F+	13	S	Rooney's	
JT	08/2	1:03	9,359.0	203	38	F+	13	F	BioWest	
			502.1							
JT	08/2	1:37	"	185	43	F+	14	S	BioWest	
JT	08/2	1:49	9,363.2	203	38	F-	13	F	FIT	
			506.3							
JT	08/2	2:17	"	180	42	F-	14	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	08/2	2:32 PM	9,368.2	210	38	F-	13	F	BioWest	
			511.3							
JT	08/2	2:55	"	200	40	F+	13	S	BioWest	Filled w/3.6 gallons MeOH => 10.86 mpg
JT	08/2	3:22	9,380.5	203	38	F+	13	F	419B	
			524.6							
JT	08/2	3:47	"	192	40	F+	13	S	419B	
JT	08/2	4:20	9,392.6	215	38	F+	13	F	BioWest	
			535.7							
JT	08/2	4:25	"	218	38	F+	13	S	BioWest	
JT	08/2	6:05	9,397.2	165	60	F+	13	S	FIT	
			540.3							
JT	08/2	6:37	9,408.8	205	35	F-	13	F	419B	
			551.9							
JT	08/2	8:32 AM	"	100	65	F-	15	S	419B	Instant start with ether
JT	08/2	9:00	9,421.2	210	30	3/4+	13	F	BioWest	
			564.3							
JT	08/2	9:12	"	202	38	3/4+	13	S	BioWest	
JT	08/2	9:18	9,425.5	208	35	3/4+	13	F	FIT	
			568.6							
JT	08/2	10:12	"	180	45	3/4+	14	S	FIT	
JT	08/2	10:25	9,430.3	208	35	3/4	13	F	BioWest	Filled w/5.1 gallons MeOH => 12.18 mpg
			573.4							*Used the pump, as a faulty gauge is suspected
JT	08/2	11:27	"	190	41	F+	13	S	BioWest	
JT	08/2	11:53	9,444.0	208	38	F+	13	F	419B	
			587.1							
JT	08/2	1:06 PM	"	170	60	F+	14	S	419B	
JT	08/2	2:08	9,455.8	190	40	F+	13	S	FIT	
			598.9							

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	08/2	2:23 PM	9,460.6	215	35	F+	13	F	BioWest	
			603.7							
JT	08/2	3:08	"	190	42	F+	13	S	BioWest	
JT	08/2	3:18	9,465.7	208	38	F-	13	F	Leo's	
			608.8							
JT	08/2	3:50	9,470.7	215	38	F-	13	F	BioWest	Filled w/3.7 gallons MeOH => 10.91 mpg
			613.8							*Used the pump, as a faulty gauge is suspected
JT	08/2	4:37	"	200	40	F+	13	S	BioWest	
JT	08/2	5:05	9,484.2	210	38	F+	13	F	419B	
			627.3							
JT	08/2	8:35 AM	"	100	65	F+	16	S	419B	Easy start with ether
JT	08/2	9:06	9,496.3	210	38	F+	13	F	FIT	
			639.4							
JT	08/2	9:51	"	180	42	F+	13	S	FIT	
JT	08/2	10:06	9,501.0	205	38	F+	13	F	BioWest	
			644.1							
JT	08/2	10:58	"	175	42	F+	13	S	BioWest	
JT	08/2	11:12	9,505.4	210	35	F-	13	F	FIT	
			648.5							
JT	08/2	11:45	"	190	42	F-	13	S	FIT	
JT	08/2	11:57	9,509.2	211	35	F-	13	F	Rooney's	
			652.3							
JT	08/2	12:44	"	175	42	F-	14	S	Rooney's	AC off
JT	08/2	1:06	9,519.1	210	38	F-	13	F	BioWest	
			662.2							
JT	08/2	1:39	9,523.3	215	38	F-	13	F	FIT	
			666.4							
JT	08/2	4:35	"	140	60	F-	14	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	08/2	4:54 PM	9,528.2	210	38	3/4+	13	F	BioWest	Filled w/5.2 gallons MeOH => 11.06 mpg
			671.3							*Used the pump, as a faulty gauge is suspected
JT	08/2	5:11	"	210	38	F+	12	S	BioWest	
JT	08/2	5:33	9,536.2	210	38	F+	13	F	Rooney's	
			679.3							
JT	08/2	5:57	"	193	40	F+	13	S	Rooney's	
JT	08/2	6:25	9,549.9	202	38	F+	13	F	419B	
			693.0							
JT	08/2	8:36 AM	"	110	60	F+	15	S	419B	
JT	08/2	9:11	9,562.2	210	35	F-	13	F	BioWest	
			705.3							
JT	08/2	9:27	"	202	38	F-	13	S	BioWest	
JT	08/2	9:39	9,566.5	208	38	F-	13	F	FIT	
			709.6							
JT	08/2	10:37	"	180	42	F-	13	S	FIT	
JT	08/2	10:52	9,571.6	210	38	F-	13	F	BioWest	Filled w/4.2 gallons MeOH => 10.33 mpg
			714.7							Splash & Overflow
JT	08/2	11:51	"	180	42	F+	13	S	BioWest	*Used the pump, as a faulty gauge is suspected
JT	08/2	12:18	9,585.2	210	38	F+	13	F	419B	
			728.3							
JT	08/2	1:04	"	185	45	F+	13	S	419B	
JT	08/2	1:32	9,597.0	212	38	F+	13	F	FIT	
			740.1							
JT	08/2	2:15	"	210	38	F+	13	S	FIT	
JT	08/2	2:29	9,602.0	215	38	F+	13	F	BioWest	
			745.1							
JT	08/2	3:42	"	175	50	F+	13	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	08/2	3:57 PM	9,606.3	215	13	F+	13	F	FIT	
			749.4							
JT	08/2	4:18	"	202	38	F+	13	S	FIT	
JT	08/2	4:33	9,611.1	218	38	F+	13	F	BioWest	
			754.2							
JT	08/2	4:38	"	215	38	F-	13	S	BioWest	
JT	08/2	7:52	9,628.3	205	38	F-	13	F	419B	Stopped at JHB's house
			771.4							
JT	08/2	8:13 AM	"	100	65	F-	15	S	419B	Two shots of ether
JT	08/2	8:47	9,640.8	212	38	3/4-	13	F	BioWest	
			783.9							
JT	08/2	9:29	"	188	50	3/4-	14	S	BioWest	
JT	08/2	9:39	9,645.0	201	38	3/4-	13	F	FIT	
			788.1							
JT	08/2	10:50	9,650.3	208	35	1/2+	13	F	BioWest	Filled w/7.0 gallons MeOH => 11.24 mpg
			793.4							*Used the pump, as a faulty gauge is suspected
JT	08/2	11:22	"	210	38	F+	13	S	BioWest	
JT	08/2	11:45	9,663.9	210	35	F+	13	F	419B	
			807.0							
JT	08/2	1:22 PM	"	170	60	F+	13	S	419B	
JT	08/2	1:51	9,676.3	218	35	F+	13	F	BioWest	
			819.4							
JT	08/2	1:56	"	218	38	F+	13	S	BioWest	
JT	08/2	2:15	9,680.8	215	38	F+	13	F	FIT	AC out temporarily, temperature to 250° F
			823.9							
JT	08/2	3:04	"	190	60	F+	13	S	FIT	
" means ditto for <u>both</u> mileage 1 and mileage 2										

Operator	1998 Date	Time	Mileage 1	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	12/0	5:00 PM	9,761.5	150	60	3/4	15	S	BioWest	Started easily. Filled w/5.57 gallons MeOH
			904.6							
JT	12/0	5:37	"	150	60	F+	14	S	BioWest	Started easily
JT	12/0	6:00	9,766.1	205	35	F+	12	F	HRMC	Ran fine
			909.2							
JT	12/0	10:35	9,777.9	200	35	F+	13	F	419B	Runs very smoothly
			921.0							
JT	12/0	8:56 AM	"	100	70	F+	15	S	419B	Started w/one shot ether
JT	12/0	9:22	9,789.7	205	35	F+	14	F	FIT	
			932.8							
JT	12/0	10:35	"	165	70	F+	14	S	FIT	Started during second attempt
JT	12/0	10:50	9,794.5	202	38	F-	13	F	BioWest	
			937.6							
JT	12/0	11:43	"	170	43	F-	14	S	BioWest	
JT	12/0	12:03 PM	9,802.1	205	38	F-	13	F	Rooney's	
			945.2							
JT	12/0	12:48	"	172	43	F-	14	S	Rooney's	Started during second attempt
JT	12/0	1:16	9,812.4	200	38	F-	13	S	BioWest	
			955.5							
JT	12/0	1:31	9,816.6	205	38	3/4+	13	F	FIT	
			959.7							
JT	12/0	2:04	"	180	40	3/4+	13	S	FIT	
JT	12/0	2:08	9,817.0	200	38	3/4+	13	F	Helmstette	
			960.1							
JT	12/0	2:55	"	170	45	3/4+	13	S	Helmstette	
JT	12/0	3:12	9,821.9	208	38	3/4	13	F	BioWest	Filled w/7.3 gallons MeOH => 8.39 mpg
			965.0							
JT	12/0	5:00	"	170	60	F+	13	S	BioWest	
JT	12/0	5:37	9,835.5	202	35	F+	12	F	419B	
			978.6							
JT	12/0	8:20 AM	"	100	60	F+	14	S	419B	Instant start with ether

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	12/0	8:47 AM	9,849.9	195	38	F+	13	F	BioWest	
			993.0							
JT	12/0	8:52	"	195	38	F+	13	S	BioWest	
JT	12/0	9:05	9,852.1	200	38	F-	13	F	FIT	
			995.2							
JT	12/0	10:34	9,856.9	202	38	F-	13	F	BioWest	
			000.0							
JT	12/0	11:31	"	165	50	F-	14	S	BioWest	
JT	12/0	12:00 NN	9,870.3	208	35	F-	13	F	419B	
			013.6							
JT	12/0	1:00 PM	9,870.6	170	45	F-	13	S	419B	
			013.4							
JT	12/0	1:30	9,882.9	210	33	3/4	13	F	BioWest	
			026.0							
JT	12/0	1:37	"	208	35	3/4	13	S	BioWest	
JT	12/0	1:55	9,887.2	208	35	3/4	12	F	FIT	
			030.3							
JT	12/0	2:55	"	172	45	3/4	13	S	FIT	
JT	12/0	3:12	9,892.1	205	38	3/4-	12	F	BioWest	Filled w/6.62 gallons MeOH => 10.61 mpg
			035.2							
JT	12/0	4:54	"	165	60	F+	13	S	BioWest	
JT	12/0 9	5:25	9,905.7	200	35	F+	12	F	419B	Would not start in the evening, although it started on Saturday. The car was driven on I-95 and performed OK SP to EGC to I-95 to Barnes to RTE1 to Pineda
			048.8							
JT	12/1	12:48	9,942.5	160	60	F-	15	S	419B	Started easily with one shot of ether
			085.6							
JT	12/1	1:15	9,954.4	200	38	3/4+	14	F	FIT	The car ran well
			097.5							
JT	12/1	2:35	"	150	60	3/4+	14	S	FIT	Started easily
JT	12/1	2:50	9,958.9	200	38	3/4	13	F	BioWest	Filled w/5.7 gallons MeOH => 11.72 mpg
			102.0							
JT	12/1	4:35	"	140	60	F+	15	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	12/1	5:05 PM	9,972.5	205	35	F+	13	F	419B	
			115.6							
JT	12/1	10:52	"	100	60	F+	15	S	419B	Two shots of ether
JT	12/1	11:27	9,996.1	205	38	F+	14	F	FSEC	
			139.2							
JT	12/1	8:13	10,022.8	100	65	F-	15	S	419B	Cold morning; started easily with one shot of ether
			165.9							
JT	12/1	8:40	10,034.7	190	38	3/4	14	F	FIT	
			177.8							
JT	12/1	10:12	"	130	60	3/4	15	S	FIT	
JT	12/1	10:23	10,038.9	200	39	3/4	15	F	BioWest	
			182.0							
JT	12/1	12:00 NN	10,039.1	120	60	3/4	15	S	BioWest	Easy start; cold weather
			182.2							
JT	12/1	12:10	10,040.8	190	40	3/4-	14	F	Mall	
			183.9							
JT	12/1	1:17 PM	"	140	60	3/4-	14	S	Mall	
JT	12/1	1:28	10,042.7	198	38	F+	13	F	BioWest	Filed w/6.94 gallons MeOH => 12.07 mpg
			185.8							
JT	12/1	2:17	10,046.9	100	38	F+	14	F	FIT	Readings were taken w/engine off
			190.0							
JT	12/1	2:35	"	180	40	F+	14	S	FIT	
JT	12/1	2:53	10,051.4	200	38	F+	13	F	BioWest	
			194.5							
JT	12/1	5:05	10,075.6	172	45	F+	13	S	BioWest	Home via I-95 & Wickham
			218.7							
JT	12/1	5:37	10,096.9	203	38	F-	13	F	419B	
			240.0							
JT	12/1	8:42 AM	"	100	65	F-	15	S	419B	One shot of ether
JT	12/1	9:12	10,109.3	203	38	3/4+	14	F	BioWest	
			252.4							
JT	12/1	9:29	"	180	40	3/4+	15	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	12/1	9:42 AM	10,113.5	200	38	3/4	14	F	FIT	
			256.6							
JT	12/1	10:12	"	172	43	3/4	14	S	FIT	
JT	12/1	10:28	10,118.3	200	38	3/4	14	F	BioWest	
			261.4							
JT	12/1	11:40	"	150	60	3/4	15	S	BioWest	
JT	12/1	11:57	10,122.5	---	38	3/4	14	F	FIT	
			265.6							
JT	12/1	1:00 PM	"	---	60	3/4-	14	S	FIT	
JT	12/1	1:20	10,127.0	---	38	3/4-	13	F	BioWest	Filled w/7.05 gallons MeOH => 11.96 mpg
			270.1							
JT	12/1	3:00	10,129.1	---	38	F+	13	F	Mall	
			272.2							
JT	12/1	4:28	"	---	60	F+	15	S	Mall	
JT	12/1	5:00	10,144.9	---	38	F+	14	F	419B	
			288.0							
JT	12/2	8:11 AM	10,146.6	100	70	F+	15	S	419B	One shot of ether
			289.7							
JT	12/2	8:38	10,159.0	195	38	F+	13	F	BioWest	
			302.1							
JT	12/2	8:39	10,159.9	192	40	F+	13	S	Post	
			303.0							
JT	12/2	9:55	10,164.1	198	38	F-	13	F	FIT	
			307.2							
JT	12/2	10:17	"	182	42	F-	13	S	FIT	
JT	12/2	10:32	10,168.0	202	38	F-	13	F	Target	
			311.1							
JT	12/2	11:10	"	78	45	F-	13	S	Target	
JT	12/2	11:18	10,168.6	200	38	F-	13	F	BioWest	
			311.7							
JT	12/2	12:15 PM	10,176.8	200	38	F-	13	F	Rooney's	
			319.9							

" means ditto for both mileage 1 and mileage 2

Operato	1998 Date	Time	Mileage 1	Temp (*F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	12/2	4:56 PM	10,192.8	195	39	3/4-	13	F	BioWest	Filled w/6.55 gallons MeOH => 10.81 mpg
			335.9							
JT	12/2	5:22	"	180	42	F+	13	S	BioWest	Via I-95 to Wickham to Pineda to 419B
JT	12/2	5:54	10,218.8	200	38	F+	13	F	419B	
			361.9							
JT	12/2	8:07 AM	"	110	70	F+	15	S	419B	One shot of ether => 4 starts
JT	12/2	8:22	10,235.3	205	38	F+	14	F	BioWest	
			378.4							
JT	12/2	9:31	"	172	45	F-	14	S	BioWest	
JT	12/2	9:48	10,239.7	200	38	F-	13	F	FIT	
			382.8							
JT	12/2	10:48	10,243.8	202	38	F-	13	F	BioWest	
			386.9							
JT	12/2	11:30	"	172	45	F-	13	S	BioWest	
JT	12/2	11:54	10,251.8	209	37	F-	13	F	Rooney's	
			394.9							
JT	12/2	12:31 PM	"	180	42	F-	13	S	Rooney's	
JT	12/2	1:08	10,263.0	208	35	3/4	13	F	Barnes &	
			406.1							
JT	12/2	2:26	"	170	50	3/4	13	S	Barnes &	
JT	12/2	2:38	10,265.8	200	45	3/4	13	F	FIT	
			408.9							
JT	12/2	3:13	10,270.6	205	38	3/4-	13	F	BioWest	
			413.7							
JT	12/2	3:50	"	180	40	F+	13	S	BioWest	Filled w/6.44 gallons MeOH => 13.30 mpg
JT	12/2	4:29	10,284.2	202	35	F+	13	F	419B	
			427.3							
JT	12/2	8:30 AM	"	100	70	F+	15	S	419B	One shot of ether; easy start
JT	12/2	8:58	10,296.6	201	35	F+	12	F	BioWest	
			439.7							
JT	12/2	9:41	"	170	45	F+	14	S	BioWest	

" means ditto for both mileage 1 and mileage 2



Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/07/99	9:13 AM	10,305.9 449.0	100	70	F-	15	S	BioWest	1 shot of ether; cold weather
JT	01/07/99	9:28	10,310.4 453.5	195	39	F-	14	F	FIT	
JT	01/07/99	9:38	"	185	42	F-	14	S	FIT	
JT	01/07/99	9:53	10,314.9 458.0	202	38	F-	13	F	BioWest	
JT	01/07/99	10:14	10,319.1 462.2	200	38	3/4+	14	F	BioWest	
JT	01/07/99	11:31	"	160	60	3/4+	14	S	FIT	
JT	01/07/99	11:44	10,323.0 466.1	185	38	3/4	13	F	Rooney's	
JT	01/12/99	3:53 PM	10,333.1 476.2	110	60	F+	15	S	BioWest	Filled w/5.89 gallons MeOH => 10.61 mpg
JT	01/12/99	6:12	10,337.3 480.4	205	35	F+	13	F	FIT	
JT	01/12/99	8:40	10,349.3 492.4	202	35	F+	13	F	419B	
JT	01/13/99	8:50 AM	"	100	70	F+	15	S	419B	
JT	01/13/99	9:18	10,361.7 504.8	200	35	F+	14	F	BioWest	
JT	01/13/99	9:54	10,365.9 509.0	200	35	F-	14	F	FIT	
JT	01/13/99	11:07	"	160	60	F	14	S	FIT	
JT	01/13/99	11:21	10,370.4 513.5	200	38	F-	13	F	BioWest	
JT	01/13/99	11:36	"	190	40	F-	14	S	BioWest	
JT	01/13/99	12:06 PM	10,383.9 527.0	200	38	F-	13	F	419B	
JT	01/13/99	1:18	"	162	60	F-	14	S	419B	
JT	01/13/99	2:03	10,398.0 541.1	207	35	3/4+	13	F	BioWest	
JT	01/13/99	2:18	"	198	38	3/4+	13	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	01/13/99	2:33 PM	10,402.2 545.3	200	38	3/4	13	F	FIT	
JT	01/13/99	3:20	"	170	50	3/4	13	S	FIT	
JT	01/13/99	3:40	10,407.0 550.1	202	38	3/4	13	F	BioWest	Filled w/6.57 gallons M-100 => 11.25 mpg
JT	01/13/99	5:06	"	198	38	F+	13	F	Rooney's	
JT	01/13/99	5:47	10,415.0 558.1	170	50	F+	13	S	Rooney's	
JT	01/13/99	6:15	10,428.7 571.8	198	35	F+	13	F	419B	
JT	01/14/99	8:39	"	100	72	F+	15	S	419B	
JT	01/14/99	9:22	10,443.3 586.4	206	35	F+	14	F	BioWest	
JT	01/14/99	9:55	"	175	42	F-	14	S	BioWest	
JT	01/14/99	10:08	10,447.8 590.9	192	38	F-	13	F	FIT	
JT	01/14/99	10:47	"	170	43	F-	14	S	FIT	
JT	01/14/99	11:03	10,452.1 595.1	204	35	F-	13	F	BioWest	
JT	01/14/99	11:28	"	180	42	F-	14	S	BioWest	
JT	01/14/99	12:00 PM	10,465.7 608.7	200	38	F-	13	F	419B	
JT	01/14/99	12:52	"	170	55	F-	14	S	419B	
JT	01/14/99	1:22	10,478.2 621.2	202	35	3/4	13	F	FIT	
JT	01/14/99	2:08	10,482.4 625.4	205	35	3/4	13	F	BioWest	Filled w/6.03 gallons M-100 => 12.50 mpg
JT	01/14/99	4:37	"	140	60	F+	14	S	BioWest	
JT	01/14/99	5:20	10,490.8 633.8	198	35	F+	13	F	Rooney's	Taken to Alternative Auto for new fuel pump
JT	02/04/99	9:23 AM	10,525.1 668.1	120	60	F-	14	S	BioWest	Instant start. 1 shot ether

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	02/04/99	9:38 AM	10,529.5	195	38	3/4+	13	F	FIT	Taken to Alternative Auto to repair AC wiring. Also needed new Schrader valve. The old one caused large MeOH leak in engine compartment
			672.5							
JT	02/04/99	10:15	"	172	45	3/4+	13	S	FIT	
JT	2/23/99	1:13 PM	10,551.1	145	60	F+	14	S	BioWest	Filled w/9.58 gallons M-100
			694.1							
JT	2/23/99	1:42	10,555.3	205	38	F+	12	F	FIT	Runs well
			698.3							
JT	2/23/99	2:55	10,572.8	203	38	F+	13	F	FIT	Runs well
			715.8							
JT	2/23/99	4:38	10,584.5	200	38	F+	13	F	419B	Runs well
			727.5							
JT	2/24/99	8:00 AM	"	130	60	F-	15	S	419B	Easy start; 1 shot ether
JT	2/24/99	8:28	10,596.6	209	35	F-	14	F	FIT	
			739.6							
JT	2/24/99	9:42	10,601.4	200	35	F-	14	F	BioWest	
			744.4							
JT	02/24/99	2:36 PM	10,632.7	180	44	F+	14	S	BioWest	Filled w/6.41 gallons M-100 => 12.7 mpg
			775.7							
JT	02/24/99	2:52	10,636.9	202	38	F+	13	F	FIT	
			779.9							
JT	02/24/99	3:14	"	190	40	F+	14	S	FIT	
JT	02/24/99	5:45	10,662.9	200	35	F+	13	F	419B	
			805.9							
JT	03/08/99	8:48 AM	10,694.0	100	60	3/4+	14	S	419B	Instant start w/ether
			837.0							
JT	03/08/99	9:16	10,705.7	195	38	3/4-	13	F	FIT	
			848.7							
JT	03/08/99	11:08	"	130	60	3/4-	14	S	FIT	
JT	03/08/99	12:00	10,710.6			F+		S	BioWest	Filled w/7.43 gallons M-100 => 10.46 mpg
			853.6							

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	2/24/99	12:35 PM	10,724.2	205	35	F+	13	F	419B	
			867.2							
JT	2/24/99	1:34	"	170	50	F+	14	S	419B	
JT	2/24/99	3:02	10,741.7	202	38	F+	13	F	FIT	
			884.7							
JT	03/09/99	8:33 AM	10,761.7	150	60	F-	14	S	419B	
			904.7							
JT	03/09/99	12:36 PM	10,785.8	160	60	3/4	14	S	Rooney's	
			928.8							
JT	03/09/99	12:55	10,795.7					F	BioWest	Filled w/7.58 gallons M-100 => 11.22 mpg
			938.7							
JT	03/09/99	1:55	10,809.2	201	35	F+	13	F	419B	
			952.2							
JT	03/12/99	9:13 AM	"	110	70	F+	15	S	419B	Easy start; 1 shot ether
JT	03/12/99	9:49	10,822.0	205	38	F+	12	F	BioWest	
			965.0							
JT	03/12/99	10:15	"	190	40	F+	13	S	BioWest	
JT	03/12/99	11:50	10,826.5	165	55	F+	13	F	FIT	
			969.5							
JT	03/12/99	1:28 PM	10,830.3	160	55	F+	14	S	Rooney's	
			973.3							
JT	03/12/99	1:40	10,834.3	200	38	F-	13	F	FIT	
			977.3							
JT	03/12/99	2:13	10,838.8	208	38	F-	13	F	BioWest	
			981.8							
JT	03/12/99	4:05	"	155	60	F-	13	S	BioWest	
JT	03/12/99	4:39	10,852.4	205	38	F-	12	F	419B	
			995.4							
JT	03/15/99	8:28 AM	"	100	60	3/4+	14	S	419B	Cold day; 1 shot ether
JT	03/15/99	8:58	10,864.7	205	38	3/4	13	F	BioWest	
			007.7							
JT	03/15/99	9:13	"	190	38	3/4	14	S	BioWest	

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/15/99	9:25 AM	10,868.8	205	38	3/4	13	F	FIT	
			011.8							
JT	03/15/99	1:19 PM	10,872.8	195	38	3/4-	13	S	BioWest	Filled w/7.4 gallons M-100 => 10.42 mpg
			015.8							
JT	03/15/99	3:27	10,877.1	200	38	F+	13	F	FIT	
			020.1							
JT	03/16/99	7:50 AM	10,895.5	100	70	F+	15	S	419B	Cold day; 1 shot ether
			038.5							
JT	03/16/99	8:23	10,907.9	200	38	F-	13	F	BioWest	
			050.9							
JT	03/16/99	9:50	"	140	60	F-	13	S	BioWest	
JT	03/16/99	10:03	10,912.1	200	38	F-	13	F	FIT	
			55.1							
JT	03/16/99	11:35	10,916.1	198	38	F-	13	F	Rooney's	
			59.1							
JT	03/16/99	2:53 PM	10,931.1	180	40	F-	13	S	FIT	
			74.1							
JT	03/16/99	3:50	10,936.4	205	36	3/4+	12	F	BioWest	
			079.4							
JT	03/16/99	5:11	10,948.4	200	36	3/4-	13	F	FIT	
			091.4							
JT	03/16/99	8:20 AM	10,960.1	205	35	3/4-	12	F	419B	
			103.1							
JT	03/17/99	1:00 PM	"	100	60	F+	14	S	419B	Added 7.0 gallons M-100; not filled
JT	03/17/99	1:37	10,976.0	202	38	F+	13	F	BioWest	
			119.0							
JT	03/17/99	1:57	10,980.1	203	35	F+	13	F	FIT	
			123.1							
JT	03/17/99	3:38	10,986.5	180	42	F+	13	S	BioWest	Filled to overflow w/MeOH
			129.5							
JT	03/18/99	8:47 AM	11,008.1	100	70	F+	15	S	419B	Easy start - 1 shot ether
			151.1							
JT	03/18/99	9:16	11,020.5	205	35	F+	13	F	BioWest	
			163.5							

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/18/99	3:30 PM	11,057.2 200.2	210	38	3/4	12	F	BioWest	Filled w/6.29 gallons M-100 => 11.24 mpg
JT	03/18/99	4:47	11,065.6 208.6	205	35	F+	13	F	Rooney's	
JT	03/18/99	5:51	11,069.8 212.8	200	35	F+	12	F	FIT	
JT	03/18/99	8:22 AM	11,081.4 224.4	204	35	F+	13	F	419B	
JT	03/19/99	8:44	"	100	72	F+	15	S	419B	Warm day. Would not start w/o ether
JT	03/19/99	9:14	11,093.9 236.0	210	25	F-	13	F	BioWest	
JT	03/19/99	1:32 PM	11,116.1 259.1	208	35	F-	12	F	FIT	
JT	03/19/99	5:37	11,142.7 285.7	206	35	3/4-	13	F	419B	
JT	03/22/99	12:33	"	100	70	F+	15	S	419B	Filled w/7.96 gallons M-100 => 10.74 mpg
JT	03/22/99	1:03	11,155.1 298.1	208	35	F+	13	F	BioWest	
JT	03/22/99	3:30	11,165.7 308.7	208	35	F+	12	F	BioWest	
JT	03/23/99	8:42 AM	11,181.6 324.6	100	60	F-	14	S	419B	Started w/1 shot ether
JT	03/23/99	9:07	11,193.3 336.3	208	35	F-	13	F	FIT	
JT	03/23/99	2:07 PM	11,225.0 368.0	170	42	F+	13	S	BioWest	Filled w/7.18 gallons M-100 => 11.46 mpg
JT	03/23/99	2:20	11,229.3 372.3	203	38	F+	13	F	FIT	
JT	03/24/99	9:55 AM	11,275.7 418.7	175	42	F-	13	S	BioWest	
JT	03/24/99	10:32	11,280.0 423.0	180	42	F-	13	S	FIT	

" means ditto for both mileage 1 and mileage 2

Operator	Date	Time	Mileage 1 Mileage 2	Temp (°F)	Oil (psi)	Fuel	Batt (V)	Start (S) Finish (F)	Place	Comments
JT	03/24/99	10:47	11,284.8 427.9	205	38	F-	13	F	BioWest	
JT	03/24/99	11:27	"	180	40	F-	13	S	BioWest	
JT	03/24/99	11:58	11,298.4 441.5	202	38	3/4	13	F	419B	
JT	03/24/99	12:52	"	170	42	3/4	13	S	419B	
JT	03/24/99	1:25	11,301.8 444.9	208	35	3/4-	13	F	BioWest	
JT	03/24/99	2:30	11,310.8 453.9	175	45	F+	13	S	BioWest	Filled w/7.46 gallons M-100 => 11.50 mpg
JT	03/24/99	3:17	11,315.0 458.1	178	40	F+	13	S	FIT	
JT	03/24/99	3:32	11,319.5 462.6	212	22	F+	12	F	BioWest	Bad hum
JT	03/25/99	9:00 AM	11,349.3 492.4	100	70	F-	15	S	419B	Hard starting w/ether
JT	"	9:50	11,365.9 509.0	203	38	F-	13	F	BioWest	Bad hum. To FIT, then To BioWest. Fuel pump bad
JT	03/30/99	1:25 PM	11,366.0 509.1	155	70	3/4+	14	S	BioWest	No hum.
JT	"	1:42	11,370.2 513.3	200	38	3/4+	13	F	FIT	
JT	"	2:30	"	172	42	3/4+	14	S	FIT	No hum
JT	"	2:46	11,374.8 517.9	200	38	3/4	12	F	BioWest	Required 2 shots ether to start Hum returned
JT	03/31/99	2:10	"	105	70	3/4	14	S	BioWest	Hard starting. Needed
JT	"	2:47	11,379.1 522.2	203	38	3/4-	12	F	FIT	Low hum
JT	03/31/99	3:14	"	180	40	3/4-	13	S	FIT	Easy start
JT	"	3:30	11,384.0 527.1	208	35	1/2+	13	F	BioWest	

" means ditto for both mileage 1 and mileage 2

**ROAD DATA**  
**FOR THE**  
**1993 FORD TAURUS**  
**FLEXIBLE-FUEL VEHICLE**  
**UTILIZING M-0 TO M-85 FUEL**

## Road Data for the '93 Flexible Fueled Ford Taurus

1998 Date	Time	Place	Miles	%MeOH Digital Displav	% MeOH In Vehicle	Miles to Emptv	Avg. mpg Digital Displav	Calculated Mpg	Comments
7/16	8:00 AM	Dearborn	41,690.3	5	--	--	26.0	--	
7/18	10:30 PM	419 B	42,922.2	0	0	--	27.9	28.8	
7/24	8:00 AM	3325 W	43,432.5	0	0	--	19.1		
7/25	5:00 PM	3325 W	43,490.9	0	0	--	18.5		
7/26	5:00	3325 W	43,495.5	0	0	--	18.0		
7/27	5:00	3325 W	43,578.8	0	0	--	18.7		
7/28	6:10	419 B	43,668.4	0	0	--	19.2		
7/30		419 B	43,858.6	0	0	--	19.9		
8/3	6:05	419 B	44,095.4	M-85	M-67	--	13.6	12.64	Filled w/M-85 16.46 gal; 4.34 gal left in
8/4	5:45	419 B	44,209.7	M-85	M-67	--	12.9	12.64	
8/5	5:30	419 B	44,279.2	M-85	M-67	--	12.9	12.64	
8/6	2:30	3325 W	44,291.5	M-85	M-67	50	12.9	12.64	Filled w/M-85
8/6	3:00	3325 W	44,291.5	M-25	M-82	324	12.9	11.21	
8/6	5:15	419 B	44,346.1	M-85	M-82	263	1.7	11.21	
8/7	5:08	419 B	44,441.8	M-85	M-82	178	12.6	11.21	
8/10	2:00	3325 W	44,466.9	M-85	M-83 - -85	224	12.6	< 11.21	Filled w/M-85 to 10 bars
8/10	5:15	419 B	44,487.1	M-85	M-83 - -85	203	12.5	< 11.21	
8/11	2:30	419 B	44,493.1	M-85	M-83 - -85	197	12.5	< 11.21	Added 5 gallons M-85
8/12	7:50 AM	419 B	44,583.0	M-85	M-83 - -85	180	12.7	< 11.21	
8/12	11:15	3325 W		M-85	M-85		19.6	16.70	I-95 driving
8/15 -									Gasoline
8/18	2:30 PM	3325 W	--	M-85	M - > -59	62	16.1	< 13.40	Added M-70
8/20	10:30	FIT	45,058.0	M-85	M - > -59				
9/3	2:30 PM	3325 W	45,139.4	M-85	M - > -59	56	16.1	13.40	Filled w/18.33 gallons M-70
9/3	2:30	3325 W	45,139.4	M-85	M-70	330	15.0	12.25	
9/3	8:15 AM	419 B	45,187.8	M-85	M-70	283	15.0	12.25	
9/4	5:14 PM	3325 W	45,203.8	M-85	M-70	215	14.8	12.25	

<b>1998 Date</b>	<b>Time</b>	<b>Place</b>	<b>Miles</b>	<b>%MeOH Digital Display</b>	<b>% MeOH In Vehicle</b>	<b>Miles to Empty</b>	<b>Avg. mpg Digital Display</b>	<b>Calculated Mpg</b>	<b>Comments</b>
9/8	1:37 PM	3325 W	45,298.3	M-85	M-70	158	14.6	12.25	
9/8	6:05	419 B	45,330.6	M-85	M-70	119	14.5	12.25	
9/9	9:03 AM	419 B	45,330.6	M-85	M-70	119	14.5	12.25	
9/9	9:30	FIT	45,342.2	M-85	M-70	105	14.5	12.25	
9/9	11:58	419 B	45,361.6	M-85	M-70	79	14.5	12.25	
9/9	1:30 PM	FIT	45,373.9	M-85	M-70	64	14.5	12.25	
9/9	3:00	3325 W	45,378.9	M-55	M-70	305	14.5	12.25	Added 11.9 gallons M-70
9/9	6:20	419 B	--	M-55	M-70	263	14.6	12.25	
9/10	8:20 AM	419 B	--	M-55	M-70	263	14.6	12.25	
9/10	11:40	FIT	45,426.5	M-55	M-70	251	14.6	12.25	
9/10	12:06 PM	419 B	45,444.8	M-55	M-70	231	14.7	12.25	
9/10	1:33	FIT	45,456.4	M-55	M-70	--	14.7	12.25	
9/10	5:18	419 B	45,485.4	M-55	M-70	187	14.7	12.25	
9/11	11:30	3325 W	45,502.1	M-55	M-70	169	14.7	12.25	
9/11	1:10 PM	3325 W	45,532.7	M-55	M-70	133	14.8	12.25	
9/14	8:38 AM	3325 W	45,580.5	M-55	M-70	77	14.8	12.25	
9/14	11:12	3325 W	45,589.6	M-55	M-70	65	14.8	12.25	
9/14	11:30	3325 W	45,603.0	M-65	M-58	348	14.8	13.49	Filled w/16.7 gallons M-55
9/14	1:30 PM	FIT	45,614.7	M-65	M-58	337	14.8	13.49	
9/14	2:55	3325 W	45,625.5	M-65	M-58	327	14.8	13.49	
9/14	6:13	419 B	45,647.3	M-65	M-58	305	14.8	13.49	
9/15	10:00	FIT	45,659.5	M-65	M-58	291	14.8	13.49	
9/15	1:10	3325 W	45,683.7	M-65	M-58	264	14.8	13.49	
9/16	8:15	419 B	45,717.7	M-65	M-58	223	14.8	13.49	
9/16	8:50	3325 W	45,730.0	M-65	M-58	209	14.8	13.49	
9/16	12:01 PM	419 B	45,747.5	M-65	M-58	187	14.8	13.49	
9/16	1:27	3325 W	45,759.7	M-65	M-58	172	14.8	13.49	
9/16	6:22	419 B	45,790.7	M-65	M-58	134	14.7	13.49	
9/17	8:20 AM	419 B	45,802.7	M-65	M-58	119	14.7	13.49	



1998 Date	Time	Place	Miles	%MeOH Digital Displav	Miles to Emptv	Avg. mpg Digital Displav	Comments
9-28	9:20 AM	BioWest	46,360.2	M-55	136	15.1	
9-28	12:00 NN	419-B	46,383.0	M-55	105	15.1	
9-28	1:32 PM	BioWest	46,395.3	M-55	89	15.1	At 42 mi. left, filled w/ 5 gallons gasoline at 6:00 PM
9-29	7:55 AM	419-B	46,435.6	M-35	133	15.2	
10-01	1:25 PM	BioWest	46,674.7	M-00	79		Running on gasoline
10-01	2:45	BioWest	46,674.8	M-45			Filled w/16.25 gallons M-40
10-01		FIT	46,679.0		430	15.6	
10-01	5:08	BioWest	46,686.3	M-45	423	15.6	
10-01	6:57	419-B	46,701.1	M-45	408	15.6	
10-02	8:05 AM		46,701.1	M-45	408	15.6	
10-02	8:35	BioWest	46,701.1	M-45	408	15.6	
10-02	4:30 PM	BioWest	46,749.4	M-45	355	15.6	
10-03	9:55 AM	419-B	46,770.9	M-45	329	15.6	
10-03	10:25	BioWest	46,783.2	M-45	314	15.6	
10-03	4:10 PM	BioWest	46,799.4	M-45	294	15.6	
10-03	4:40	BioWest	46,812.9	M-45	277	15.7	
10-05	8:47 AM	FIT	46,855.0	M-45	225	15.7	
10-06	7:56	419-B	46,937.6	M-45	116	15.7	
10-06	8:22	FIT	46,949.2	M-45	101	15.8	
10-06	1:03 PM	BioWest	46,972.2	M-45	66	15.8	
10-07	2:44	BioWest	46,981.3	M-45	50	15.8	
10-07	5:42	Rooney's	46,989.5	-0-	269	15.7	10 gallons gas added at FIT before return at 5:00
		FIT	46,985.8				
10-08	1:03	Mobil, SatBch	47,038.9	-0-		15.8	Added 3 quarts oil (oil light on)
10-08	1:29	BioWest	47,050.8	-0-		15.8	
10-08	4:45	Rooney's	47,067.7	-0-	186	15.8	
10-08	8:50 AM	FIT	47,093.1	-0-	159	15.9	Evidence of oil leak yesterday
10-23	1:22 PM	BioWest	47,126.2	-0-	120	15.9	Oil leak fixed (ruptured oil filter)
10-23	2:10	BioWest	47,127.6	M-35	440	15.9	Filled w/17.5 gallons M-40
10-23	9:18	419-B	47,177.3	M-35	392	15.9	

1998 Date	Time	Place	Miles	%MeOH Digital Display	Miles to Empty	Avg. mpg Digital Display	Comments
10-26	7:52 AM	419-B		M-35	392	15.9	
10-26	8:25	BioWest	47,189.6	M-35	382	15.9	
10-26	12:03 PM		47,211.3	M-35	357	15.9	Car would not start at 4:30 on the 26 <sup>th</sup> . Battery terminals were cleaned. Car started on the 27 <sup>th</sup> .
10-28	7:50 AM	419-B	47,250.1	M-35	299	15.9	
10-28	8:27	BioWest	47,262.4	M-35	285	18.3	
10-28	12:50 PM	419-B	47,291.3	M-35	253	17.8	
10-28	5:45	419-B	47,345.9	M-35	191	17.7	
10-29	8:18 AM	419-B	47,352.4	M-35	185	17.4	
10-29	12:55 PM	419-B	47,389.4	M-35	142	17.7	
10-29	4:45	FIT	47,405.9	M-35	123	17.5	
10-30	8:32 AM	419-B	47,439.7	M-35	83	17.5	
10-30	1:30 PM	BioWest					Filled w/17.75 gallons M-40
10-30	1:42	BioWest	47,456.2	M-35	457	17.4	Theoretical mileage = 15.2 mpg, 15.9 if 1.7 used in place of 2; Calculated mpg = 18.51
11-02	8:02 AM	419-B	47,495.0	M-35	418	17.1	
11-02	1:53 PM	FIT	47,543.7	M-35	367	17.1	
11-03	7:50 AM	419-B	47,576.7	M-35	329	17.0	
11-03	8:18	BioWest	47,589.0	M-35	315	17.0	
11-03	2:30 PM	BioWest	47,622.1	M-35	275	17.1	
11-03	5:15		47,638.7	M-35	254	17.0	
11-04	7:47 AM		47,638.7	M-35	254	17.0	
11-04	8:23	FIT	47,651.4	M-35	238	17.0	
11-05	8:23	419-B	47,712.5	M-35	160	16.9	
11-05	9:10	FIT	47,729.4	M-35	137	16.9	
11-05	12:15 PM	419-B	47,751.6	M-35	106	16.9	
11-05	4:06	BioWest	47,773.1	M-35	70	16.8	Filled w/18.6 gallons M-25. Theoretical mileage = 15.2 or 15.9; Calculated mpg = 17.04.
11-05	5:00	BioWest	47,773.2	M-35	440	16.8	
11-05	6:17	419-B	47,796.0	M-35	417	16.9	
11-06	8:38 AM	419-B	47,796.0	M-35	417	16.9	

1998 Date	Time	Place	Miles	%MeOH Digital Display	Miles to Empty	Avg. mpg Digital Display	Comments
11-06	11:40	BioWest	47,812.1	M-35	402	16.9	
11-06	5:20 PM	Rooney's	47,858.3	M-35	358	16.9	
11-06	5:50	419-B	47,871.8	M-35	344	16.9	
11-09	8:15 AM	419-B	47,897.7	M-35	316	16.9	
11-09	10:20	BioWest	47,918.7	M-35	292	17.0	
11-10	8:00	419-B	47,969.8	M-35	235	17.0	
11-10	2:37 PM	BioWest	48,022.9	M-35	172	17.0	
11-11	8:20 AM	419-B	48,052.2	M-35	135	16.9	
11-11	12:17 PM		48,087.0	M-35	88	16.9	
11-11	4:50	BioWest	48,112.5	M-35	53	16.9	Filled w/18.39 gallons M-25; calculated. mpg = 18.46
11-11	5:25	BioWest	48,112.6	M-25	464	16.9	
11-11	7:13	419-B	48,134.0	M-25	443	16.9	
11-12	8:45 AM	FIT	48,145.7	M-25	432	17.0	
11-12	4:55 PM	BioWest	48,192.5	M-25	387	17.0	Mysterious hum
11-12	6:18	419-B	48,213.9	M-25	363	17.0	Bad hum
11-13	9:02 AM	BioWest	48,226.2	M-25	350	17.0	No hum
11-13	3:05 PM	BioWest	48,277.4	M-25	290	17.0	Gas smells
11-13	6:18	419-B	48,258.8	M-25	265	17.1	
11-16	8:15 AM	419-B	48,298.8	M-25	265	17.1	
11-16	8:45	BioWest	48,311.1	M-25	251	17.1	
11-16	3:32 PM	FIT	48,363.3	M-25	188	17.2	
11-18	8:23 AM		48,380.5	M-25	167		??? no hum ???
11-18	5:53 PM	Rooney's	48,478.3	M-25	47		Light flashing empty, buzzer ringing
11-18	5:59	Rooney's	48,478.3	M-15	84		Added 2 gallons gasoline
11-18	6:27	419-B	48,490.7	M-15	71		
11-19	12:17	BioWest	48,507.2	M-15	51		Filled w/16.7 gallons M-15. Theoretical mpg = 17.08; calculated. mpg = 21.0.if filled w/18.2 gallons; Calculated mpg = 19.53
11-19	5:50	Rooney's	48,524.6	-0-	524	17.4	
11-20	8:18 AM	419-B	48,538.1	-0-	511	17.4	
11-20	8:48	BioWest	48,550.4	-0-	499	17.4	
11-20	1:47 PM	BioWest	48,588.3	-0-	457	17.4	

1998 Date	Time	Place	Miles	%MeOH Digital Display	Miles to Empty	Avg. mpg Digital Display	Comments
11-20	4:09 PM	419-B	48,611.3	-0-	428	17.4	
11-23	8:00 AM	419-B	48,628.8	-0-	406	17.4	
11-24	8:00	419-B	48,712.7	-0-	314	17.5	
11-24	8:32	BioWest	48,712.7	-0-	297	17.5	
11-24	1:40 PM	FIT	48,743.9	-0-	255	17.5	
11-24	5:10	419-B	48,764.6	-0-	226	17.5	
11-25	8:02 AM	419-B	48,764.6	-0-	226	17.5	
11-25	8:27	FIT	48,776.3	-0-	209	17.6	
12-02	12:00	419-B	48,840.6	-0-	103	17.6	
12-02	3:40 PM	BioWest	48,865.3	-0-	53	17.6	Filled w/18.11 gallons M-15; Calculated mpg = 19.77
12-02	4:42	BioWest	48,865.3	-0-	548	17.6	
12-03	12:12	419-B	48,913.8	-0-	499	17.6	
12-03	3:08	FIT	48,944.4	-0-	465	17.6	
12-03	7:42	419-B	48,970.6	-0-	433	17.7	
12-04	11:57	Rooney's	48,995.2	-0-	402	17.7	
12-04	2:15 PM	FIT	49,009.2	-0-	384	17.7	
12-07	10:00 AM	FIT	49,104.1	-0-	260	17.8	Car taken to Kraftmaster's to repair hood & internals. Car returned to routine operation on Dec. 16. Kraftmaster's washed & cleaned car.
12-23	10:50	BioWest	49,227.7	-0-	58	17.8	Filled w/15.77 gallons M-15 + 2.52 gallons M-85 = 18.29 Calculated mpg = 19.81
12-23	12:20	419-B	49,246.3	M-25	460	17.8	
12-23	1:43	FIT	49,253.0	M-25	449	17.8	
12-23	3:03	BioWest	49,257.5	M-25	444	17.8	
12-23	5:00	419-B	49,270.9	M-25	431	17.8	
12-24	10:18	BioWest	49,283.2	M-25	418	17.8	
12-24	12:08	419-B	49,305.9	M-25	392	17.8	
12-30	9:20	419-B	49,369.4	M-2 5	317	17.8	
12-31	10:04	419-B	49,391.9	M-25	289	17.8	